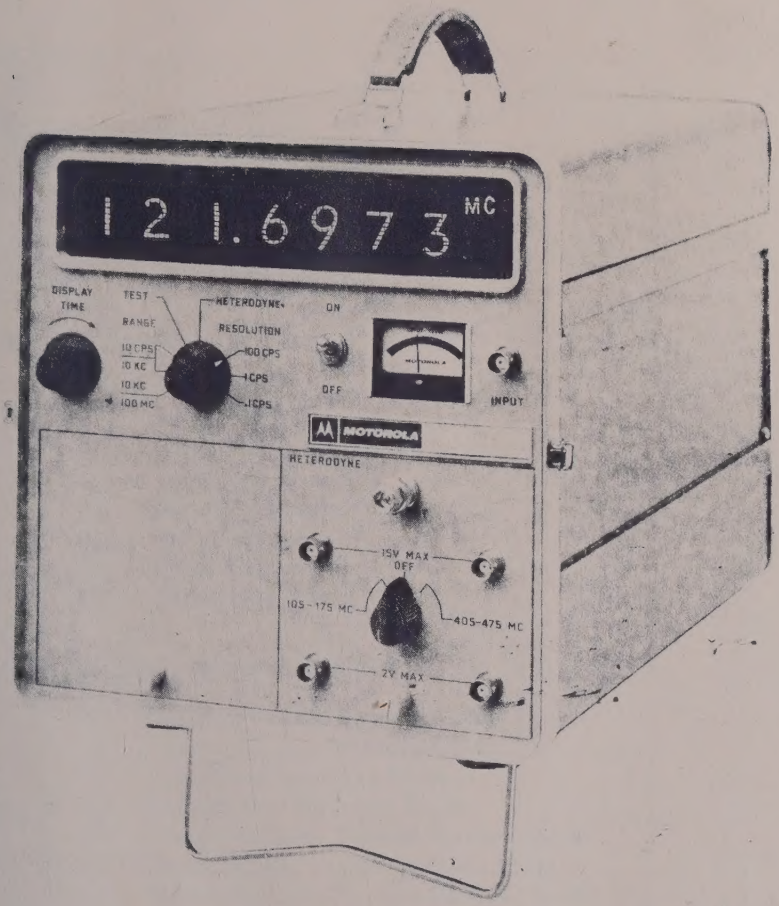
MOTOROLA

DIGITAL FREQUENCY METER

MODEL S1075A



MP MASTER
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MOTOROLA INC.

COMMUNICATIONS DIVISION

Printed in U.S.A.

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LIST OF SCHEMATIC DIAGRAMS APPENDED

Title	Motorola Dwg. No.
Block Diagram	63E-866840
100MC Amplifier and Prescaler	63E-866841
Control Circuits	63E-866842
2.5MC Decade and Gate	63E-866843
250KC Decade	63E-866844
Time Base	63E-866845
Power Supply	63E-866846
Range Indicator	63E-866847
Mother Boards	63E-866848
Heterodyne Unit	63E-866849

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4910 West Flournoy Street
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MOTOROLA DIGITAL FREQUENCY METER
MODEL S1075A

1—General Description

1.1 FUNCTIONS:

The Motorola Digital Frequency Meter is a solid-state instrument capable of making direct frequency measurements up to 100 megacycles per second. Facilities are included for range extender units which provide two additional ranges of frequency measurement by the heterodyne technique:

105 to 175 megacycles per second.
405 to 475 megacycles

All frequency measurements are indicated on the 7 digit in-line readout in units of cycles or megacycles. Automatic decimal point and units indication is provided in all measurement ranges. Measurements at the 10 cps to 10 kilocycle range can be made with either 1 cps or 0.1 cps resolution. All measurements in the megacycle range are indicated to the nearest 100 cps.

1.2 FEATURES:

The Motorola Digital Frequency Meter is designed for simple, reliable operation and easy maintenance. Its circuitry is fully transistorized and constructed on compact modular printed circuit boards. Accuracy of measurement is assured by stability of a precision crystal oscillator.

All measuring functions of the Model S1075A are controlled by means of a single selector switch. In addition, the DISPLAY CONTROL varies the length of time that the count indication is retained before the instrument is automatically reset to zero in preparation for the start of a new counting interval.

1.3 TECHNIQUE OF MEASUREMENT:

The Model S1075A Digital Frequency Meter is able to make direct measurements at ultra high frequencies by virtue of a new ring counter design concept employing tunnel diodes. In the megacycle ranges, the input is pre-scaled (divided by 100). The pre-scaled signal is then applied to an electronic register of 7 decade counting stages connected in series. These units "count" the input signal for a precise 1 second interval, controlled by two successive output pulses from the time base generator. The indication of the readout tubes, which are controlled by the decades, is the number of cycles (in hundreds) of input signal which occur during 1 second. The decimal indicator provides a direct readout in terms of megacycles per second, accurate to ±100 cps. In the 10KC range the input signal is applied directly to the normal counting decade stages, by-passing the two pre-scaling units. In the 1 cps resolution position, only five decade counting stages are needed to read out 10,000 cps. The two slowest (farthest left) are disconnected. In the 0.1 cps position, five counting stages are also used, with indication (1)0000.0 cps but one of the unused counting stages serves as a time base divider which provides a 10 second measuring interval.

2—Specifications

General:

Temp. Range: 0° C to +50° C
Display Time: 0.1 to more than 5 seconds
Power Required: 117V ±10%, 50-60 cps
80 watts

Oscillator Stability: 5×10^{-8} with Temp. (0° C to +50° C)
±2 parts in 10^9 per day
Sensitivity: 100 MV rms or less
Dimensions: 11⅛" h, 10⁵⁄₁₆" w, 16⅞" d

	FREQUENCY RANGE		
	10cps–10KC	10KC–100MC	405MC–475MC 105MC–175MC
Input Impedance	100K ohm	50 ohm (nominal)	50 ohm (nominal)
Count Period	10 sec or 1 sec	1 sec	1 sec
Automatic Decimal Point and Indicator	CPS	MC	MC
Resolution	0.1 CPS or 1 CPS	100 CPS	100 CPS
Accuracy	±1 cps or ±.1 cps ± Stability	±100 cps ± Stability	±100 cps ± Stability
In-line Indication	5 digits	7 digits	7 digits
Measurement	Direct	Direct	Heterodyne

3—Operating Procedures

3.1 INSTALLATION:

Power: The Model S1075A operates from a power source of 117VAC ±10%, 50 to 60 cps. To convert to 230V operation, change the jumper connections on the power supply rectifier board as illustrated in Figure 10. (Remove jumpers between terminals 1 and 2 and 3 and 4. Install a new jumper between 2 and 3, using No. 22 bus wire. Change the transformer input leads from terminals 3 and 4 to 1 and 4 but leave the fan motor leads connected to 2 and 4.

Signal Connections: Input signals are applied to the BNC type INPUT jack by means of the 4 ft. coaxial cable with detachable probe or by the antenna provided with the instrument. A short coax jumper is also provided to couple the frequency extender output to the main signal input connector. (Refer to Figure 20).

CAUTION: DO NOT INSERT OR REMOVE CIRCUIT BOARDS OR PLUG-IN EXTENDER UNITS WHILE POWER IS ON.

3.2 OPERATING CONTROLS (Refer to Figure 1).

Power Switch: The Model S1075A is ready to operate in less than one minute after the power switch is turned on. About 15 minutes is required for internal oscillator stabilization, at which time accurate measurements may be made.

Display Control. The display control is used to vary the duration of the count display over the range of approximately 0.1 to more than 5 seconds before the instrument is automatically reset for the next measurement cycle. It effectively varies the sampling rate of the measurement. When the indication is small or relatively constant from one measurement to the next, the minimum display time may be used. For varying counts, a longer display time is necessary to allow time for reading.

Range Selector: The range selector is the sole measurement selector of the Model S1075A Digital Frequency Meter. In the TEST position it applies the 1 megacycle oscillator frequency to the 7 counting stages. An indication of 1000000. cps on the readout display confirms correct operation of the major part of the circuitry in the counter. A tolerance of ±1 count in the last digit is normal.

To test the entire circuitry, apply an input signal of known frequency, using the 10 KC to 100 MC range and note the indication.

The range switch selects three normal frequency measurement ranges. In the position "10 cps to 10 KC – 1 cps resolution" the frequency meter samples an input signal in the stated frequency range for a period of 1 second and then provides a measurement readout in cycles per second with resolution to ±1 cps. In the range switch position "10 cps to 10 KC – 0.1 cps resolution" the frequency meter samples the input signal in the stated frequency range for an interval of 10 seconds and then indicates the final frequency count. Since the actual count, disregarding the decimal point, would be 10 times greater in the 0.1 cps resolution position than in the 1 cps resolution position, the decimal indication is shifted to provide resolution to ±0.1 cps.

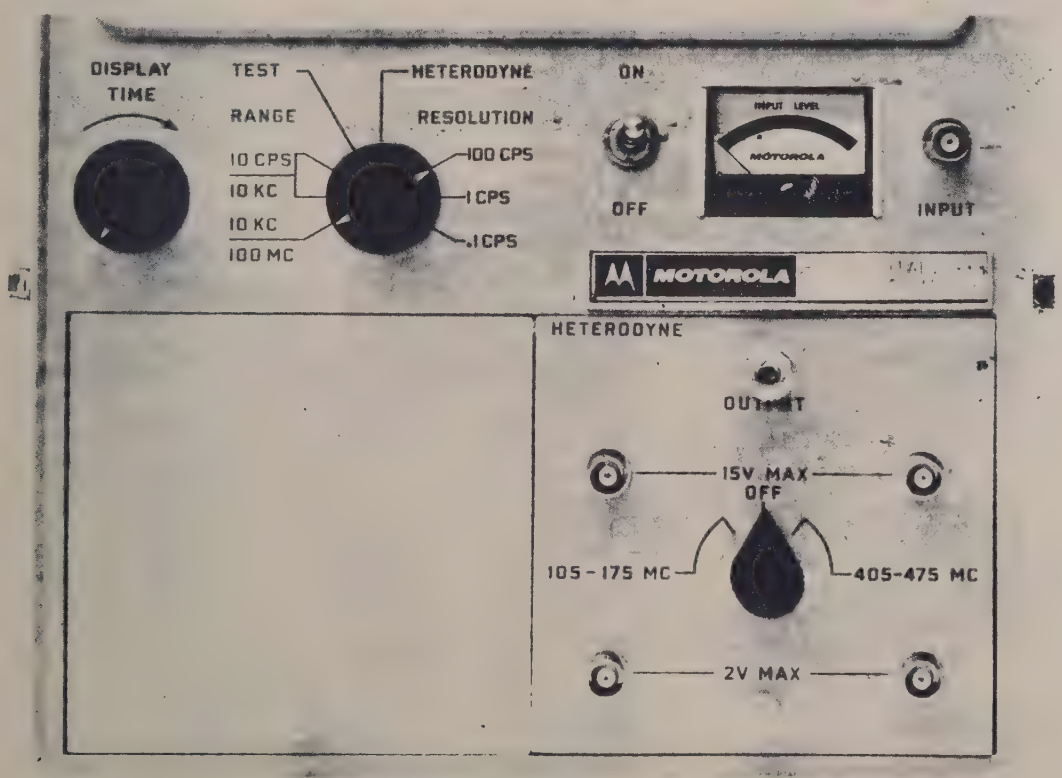

FIGURE 1. Operating Controls

In the 10 KC to 100 MC position, the readout will indicate the frequency of input signal in megacycles per second. The frequency reading is accurate to ±.0001 Mcs, which is equivalent to 100 cps resolution.

When the Model S1075A frequency meter is operated with the heterodyne frequency extender plug-in unit, the range switch must be placed in the heterodyne position.

Input Level Meter: The input Level meter operates in the 10KC to 100MC and "Heterodyne" ranges only to monitor the level of input signal applied. For proper operation of the Digital Frequency Meter, the needle should point within the green area of the meter face. An indication in the (left hand) red portion of the meter face means that the input signal level is too low to produce a reliable reading.* If the needle points to the right hand red area, the input signal is too large and will saturate the input circuitry of the counter, preventing proper operation and possibly causing damage to the circuitry if prolonged.

The recommended method of measurement of frequency of a transmitting source is to approach the transmitter from a safe distance where the input level meter indicates in the lower red region to a closer position where the meter reads in the safe (green) region. The input signal may also be attenuated to a safe level by any practical means of orienting or partially shielding the transmitter, frequency meter, or antenna.

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* Normally an indication somewhat below the green region will result in satisfactory measurements over at least the greater part of the frequency range.

Blanking. If it is desired to blank out the display during the counting cycle so that only the final count is displayed, turn on the Blanking switch found at the rear of the instrument.

Internal-External Time Base Reference. Normally the Model S1075A is operated with the rear switch in the INTernal position. A one megacycle output signal is available at the adjacent 1MC in-out jack for use as a frequency standard for auxiliary equipment. If it is desired to operate the frequency meter from an external reference frequency, as when making simultaneous measurements with two instruments, change the switch to the EXTernal position and apply the external one megacycle reference to the same rear 1MC jack. The external signal must be greater than 1 volt but less than10 volts rms. The impedance of the signal source should be at least 1000 ohms.

3.3 INPUT SIGNALS:

For all measurements except with the heterodyne unit, the input signal is applied through the coaxial cable provided to the BNC input connector on the front panel. The signal must be of at least 0.1 volt rms amplitude in order to trigger the counting circuitry. The input circuitry can withstand a voltage amplitude of 2 volts rms without affecting operation. Input impedance is 50 ohms, nominal, a.c. coupled.

3.4 EXTENDED FREQUENCY MEASUREMENTS:

The standard heterodyne plug-in unit for the Model S1075A frequency meter provides measurements in two additional ranges:

105 to 175 megacycles per second
405 to 475 megacycles per second

Operating Procedure For Heterodyne Plug-in:

(1) Connect the output jack to the Model S1075A input jack above, using the short coax cable provided.
(2) Place the front panel selector switch to the 105-175 or 405-475MC range, as required.
(3) Place the function switch of the frequency meter to the "Heterodyne" position.
(4) Apply the signal to be measured by the heterodyne unit to the appropriate input jack:
    2V rms maximum, 105 to 175 MC (lower left)
    2V rms maximum, 405 to 475 MC (lower right)
    15V rms maximum, 105 to 175 MC (upper left)
    15V rms maximum, 405 to 475 MC (upper right)
(5) Read the frequency indication displayed on the Model S1075A.

4—Circuit Description

4.1 GENERAL:

The block diagram of the Model S1075A Digital Frequency meter is shown in drawing 63E866840. The focal point of the circuit is the gate circuit included in the 2.5MC decade board. This gate is opened and closed by start and stop pulses from the control circuit which, in turn, is triggered by two successive pulses at a 1 second interval from the time base generator. When the gate is open, it passes the input signal to the following series of decimal counting units, which register the number of cycles of input signal which occur during the 1 second gate-open period.

4.2 100MC PRESCALER (Refer to Dwg. 63E 866841)

In the 10 cps to 10KC range, the Range selector shunts the input signal through an "Or" gate directly to the counting gate. In the Test position, the amplified 1 MC oscillator output is applied through the same "Or" gate to be counted by the seven counting units.

In the 10 KC to 100 MC range, the input signal is applied to the 100 MC amplifier which converts the input waveform to suitable triggering pulses. These pulses drive a divide-by-20 circuit followed by a divide-by-five circuit. The output of the latter is 1.00 MC maximum and is applied through the "Or" gate to the counting unit chain. The divide-by-20 circuit is a special ring-of-5 counter employing tunnel diodes followed by two binary flip-flops. The divide-by-5 circuit is a quinary counting unit.

The block diagram of the 100MC Prescaler circuit is included as Block 4 on the main block diagram, Dwg. 14898. A relay (K1) actuated by the Range Selector switch opens the high frequency path when the switch is in positions 2 and 3 (10cps to 10KC). The audio frequencies are amplified through the two stage amplifier having an emitter follower stage between stages (Q125 to Q128). The output of the amplifier passes through the audio gate (Q129) when the switch is in the corresponding positions only.

In the "Test" position, a 1MC signal from the time base section is applied to the TEST gate (Q131) and to the output terminal.

In the 10KC-100MC and the Heterodyne positions, the relay is energized and allows the high frequency input signal to pass to the second input amplifier channel consisting of Q102 through Q110. After the pre-amplifier stage (Q102, Q103) is a Schmitt trigger circuit which shapes the input signal into a uniform pulse suitable for operating the following counting circuit. R145 adjusts the bias level of the amplifier, which effectively determines the trigger level of the schmitt trigger.

The output of the amplifier section is divided by 5 by the following ring-of-5 counting circuit, or shift register (Q111 through Q115). This circuit is employed because of its high frequency response characteristics. The output of the ring counter is amplified and then applied to two successive binary stages (Q119 Q120 and Q122 Q123) with output buffer stages to further divide the signal frequency by 4. The divide-by-20 output signal is then fed through another divide-by-five quinary stage located physically on the control circuit board to produce the total ÷ 100 function of the prescaler. The F 100 signal is then returned to the prescaler gate (Q130) and passed on to the output terminals H and 7.

4.3 CONTROL CIRCUIT: (Dwg. 63E 866842)

The counting units stop counting at the end of one second when the input signal is shut off at the gate. The final count is displayed for an interval of time selected on the DISPLAY control. During this interval, the gate is kept closed by an inhibit bias. At the end of the display interval, a reset-to-zero pulse is applied to all counting stages and the gate inhibit bias is removed so that the next time base pulse will start a new counting cycle.

Control Binaries The output pulses from the input amplifiers and from the time base circuitry are applied to the Start and Stop inputs of the control binaries. These inputs respond only to positive going input pulses by virtue of diodes CR101 and CR107.

Assuming that the control circuitry is in the "reset" condition (all Indicator tubes register "0"), a positive "start" pulse is applied through C101 which turns off Q101 and turns on Q102 in the binary circuit. A positive-going A.C. output at the collector of Q102 turns Q103 off and Q104 on in the following binary. Consequently, a high (zero volt) Gate level output occurs at terminal F which opens the gate and causes the decimal counting units to cycle, provided that there is a "count" input signal present. If a stop impulse were received prior to the "start" pulse, this would tend to turn off the already-off Q102, and therefore nothing would happen.

When a positive "stop" pulse arrives, only binary Q103 Q104 flips, causing the Gate level output to change to a −6 volt (gate closed) level, as limited by CR105. Because the collectors of both Q103 and Q102 are now at zero potential, a +0 volts potential is applied through R109 and R110, turning off Q108 (a PNP type transistor), and producing a −6 volt End-of-Count Signal at terminal K which is connected to the blanking gate in the power supply. At the same time, Q109, is turned on (it is an NPN type) and initiates the reset signal after a delay for display interval.

Reset Signal When Q109 is turned on by the "stop" pulse, capacitor C110 charges up towards +30 volts through the series network including R131, R132, R136, and the DISPLAY TIME control. When the voltage rises to the peak point of Q110, this unijunction transistor fires and C110 discharges through T101 primary, producing a negative output pulse of approximately 10 volts from the secondary winding (terminals 3-4) which is used for PNP transistor reset, and a positive 10 volt output pulse from the other secondary winding for NPN reset.

The display time delay interval is determined by the rate of charge of C110 and can be adjusted by the Display control.

Inhibit Signal The −6 volt PNP reset signal is applied to the base of Q105, turning it on. The resulting positive voltage triggers the following one-shot multivibrator, Q106 Q107, which produces a −6 volt start inhibit signal for a duration of approximately 20 milliseconds. The time constant of the one-shot assures that the inhibit state is maintained beyond the end of the reset pulse, so that a new counting cycle cannot occur until the reset condition is fully established.

The foregoing events are summarized in Figure 2.

Divide-by-five Circuit: Functionally, this circuit is not a part of the Control circuitry but follows the Divide-by-twenty pre-scaler circuit in the input amplifier section. The Divide-by-five circuit is equivalent to the final three stages of the 2.5MC decade described in detail below. These stages form a scale-of-five, or quinary, circuit since the first binary stage necessary to form a scale of 10 is missing. The input circuit consists of an inverter stage, Q119.

4.4 TIME BASE GENERATOR: (Dwg. 63E866845)
The time base consists of an oven-controlled crystal oscillator. The 1 MC sinewave output is converted to pulses spaced precisely at 1 second intervals by six frequency divider stages. Each stage is triggered by every tenth input cycle to perform a divide-by-ten function.

The Time Base circuit card contains a 1 megacycle shaper circuit, a divide-by-two, a divide-by-five and a series of 5 frequency divide-by-ten circuits, and an output pulse selector section.

1 Megacycle Shaper: The 1 MC sinewave output from the oscillator is fed into a shaper circuit consisting of a saturating amplifier, Q201, which turns on and off with a signal level limited to +0.5 volts at its base junction by diodes CR201 and CR202. An essentially squarewave 1 MC output is produced which is coupled through output stage Q202 to the Time Base switch and also to the following divider circuit. A second output stage, Q203, couples the 1 MC squarewave to the 10 MC Multiplier. The output stage clamps the signal at -6 volts, by means of diode CR203 and CR204. The 10 pico-farad capacitor C202 and the 47 pico-farad capacitors in the following stages improve the rise time of the circuit by neutralizing the base storage charge.

Divide-by-two Circuit: The output at the collector of Q202 is also coupled to a binary stage, Q204 - Q205, which is the first in a series of frequency divider circuits that yield the descending series of time base frequencies. The binary is triggered from one stable state to another by successive positive pulses from the shaper. It produces a squarewave output at 500KC which is applied to the following divide-by-five circuit. CR207 provides DC re-storing to the differentiating network consisting of C210 and R222.

Divide-by-five Circuit: When transistor Q206 is off, capacitor C211 starts to charge up through R223 and R224, producing a rising (integrated) voltage waveform at the base of Q207. Superimposed on this rising waveform is the differentiated squarewave output from Q205. The charge rate of C211 can be adjusted by R224 so that every fifth pulse from Q205 will bring the voltage at the base of Q207 to the switching point, turning off

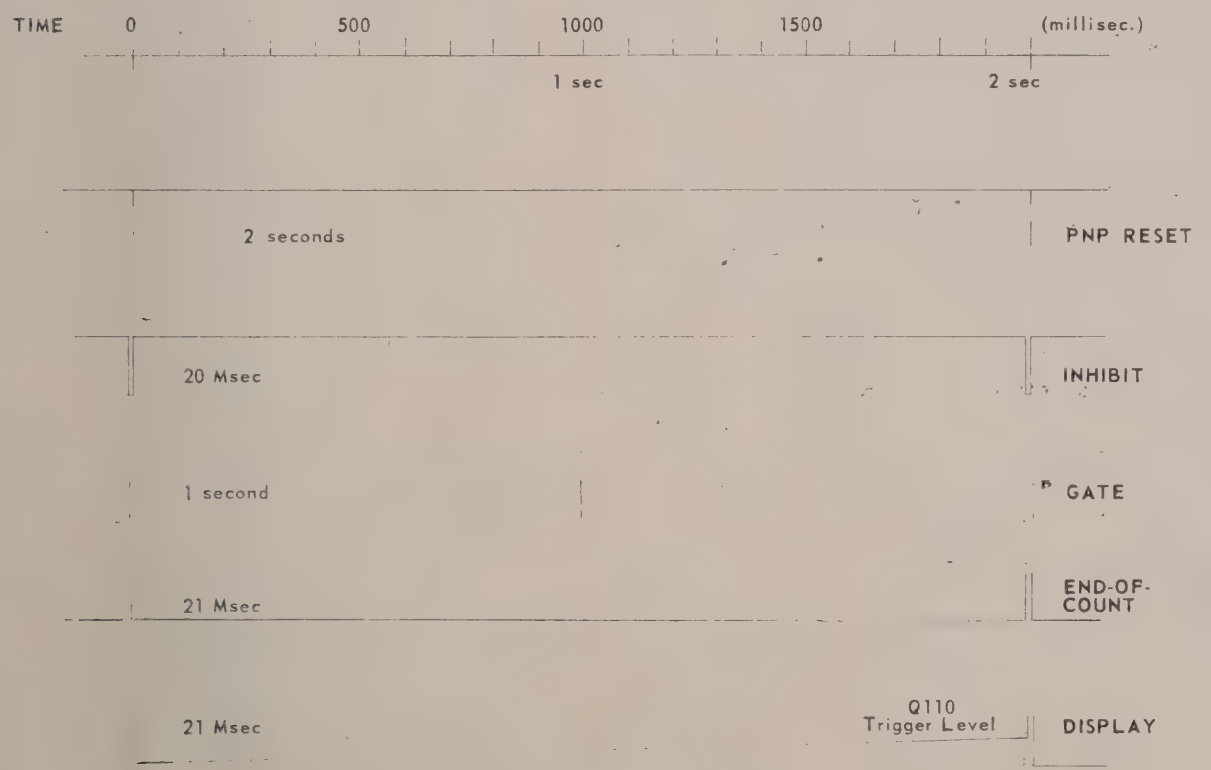


FIGURE 2. Waveforms For The Control Circuitry

Q207 and turning on Q208. This action causes Q206 to turn on and capacitor C211 discharges through it. Q207 and Q208 form a one-shot circuit. When C211 discharges, this one shot originates a pulse with a width of 1 microsecond thus imparting a well-defined wave shape to the 100 kc signal. At the same time, Q206 is turned off.

The output of the Divide-by-five circuit is the microsecond negative pulse at a 100 KC rate occurring at the collector of Q207 during its off state which is coupled to the following 10 KC divide-by-ten circuit. A second output of opposite polarity is obtained from the following saturated amplifier collector which is applied to the counting or gating circuitry through the Time Base and Function switches. Both outputs are limited in the negative excursion by diode action to -6 volts.

10 KC Divide-by-ten Circuit: The 100 KC negative pulses from Q207 are differentiated and inverted through Q210. The positive spikes which result are superimposed on the integrating waveform at the emitter of Q211, a unijunction transistor, caused by the charging up of C217.

R240 can adjust the slope of the charging waveform so that every tenth positive pulse will cause Q211 to fire and discharge the capacitor. Q211 quickly returns to the off condition and the cycle is repeated. Consequently, positive pulses are produced at the collectors of Q212 and Q213 which are applied both to the time base switch and to the following divide-by-ten circuit.

1 KC Divide-by-ten: The following four divide-by-ten circuits are identical except for the time constants of the charging capacitor network. The input circuit functions on the same principle as the preceding 10 KC circuit. A positive pulse is obtained at base 1 of Q214 which drives the succeeding divider circuit, and a negative pulse is obtained from base 2 which is applied to the Time Base switch. As described under "Time Base Pulse Selector," a negative pulse is required for time base frequencies of 1 KC and lower.

Time Base Output Pulse Selector Circuit: The desirable time base pulse should be of uniform waveform with fast rise time on the leading edge. These aims are accomplished by the pulse selector circuit in the following manner.

Q219 and Q220 form a one-shot multivibrator which produces a gating pulse of 140 (·20) microseconds in width when triggered into the unstable state by a negative pulse at the base of Q218.

This positive gating pulse appears at the base of the gate switch, Q222, turning it off and allowing the selected time base frequency which has been applied to the base of Q221 to pass through. A 10 KC signal is controlled by the selected frequency. The 140 microsecond gate width allows only one 10 KC pulse to pass through for each trigger pulse applied to the one shot circuit. Therefore, the 1 cps pulses at the output of the gate have the uniform wave shape of the 10 KC signal.

Q1 is an And gate which cuts off the time base output in the event that the 1MC oscillator signal fails Otherwise, the time base dividers could be free-running, producing a false time base.

4.5 DECIMAL COUNTING UNITS:

Each counting unit consists of four binary (flip-flop) stages interconnected to produce ten discrete voltage combinations. Ten successive input pulses cause the numerals of the corresponding indicator tubes to cycle from 0 through 9. On the tenth pulse, an output pulse is applied to the following decimal counting unit. Each decimal counting unit "counts" at one-tenth the rate of the preceeding units.

The final counting unit (related to the far left digit indicator) contains only one binary and is capable of producing an indication of 0 or 1 in the 10 KC to 175 MC ranges, 4 in the 405 to 475 MC extender range, or 8 or 9 in the 890 to 960 MC extender range. The switching logic to produce these indications is included both on the main Range selector and extender range selector switches.

The next to last indicator is not used in the 10 cps to 10 KC range. In the 10 KC range with 0.1 cps resolution, the related counting circuit is connected in series with the output of the time base to act as an additional divide-by-ten stage, as needed for a 10 second counting interval.

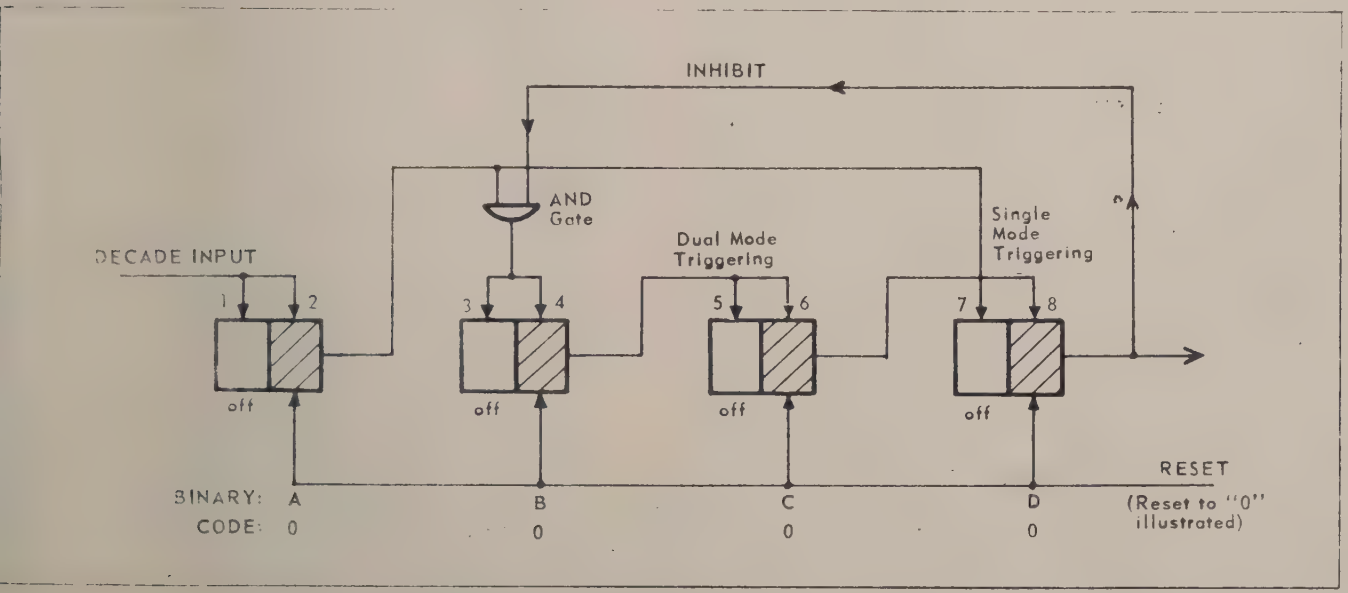


FIGURE 3. Simplified Diagram of Decade Unit

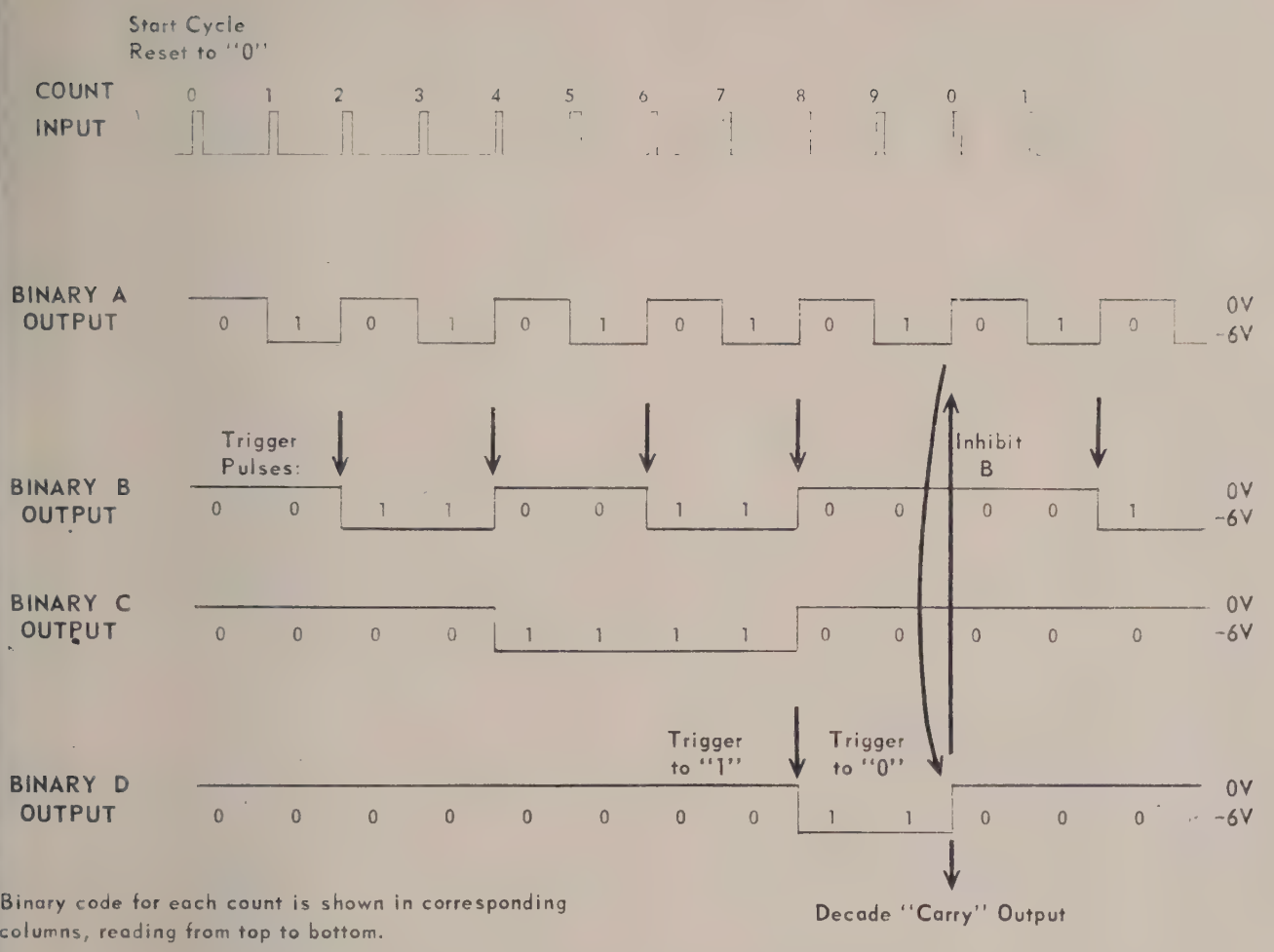


FIGURE 4. Sequence of Events in Decade Unit.

2.5 MC Decade (with Gate circuit)

This circuit uses PNP type transistors resulting in the voltage polarities given. The 250KC decades use NPN transistors and therefore all polarities are reversed. The differences between the decades in the instrument are described in subsequent paragraphs.

The basic decade or decimal counting unit consists of four binaries which operate in a chain to produce one output pulse for every ten input pulses. At the same time, ten discrete states of collector voltage levels of the four binaries are obtained to produce a scale-of-ten or binary-coded decimal output.

Each binary is triggered into one of two stable states by positive input pulses. In the "1" state, the left or odd-numbered transistor (relative to the schematic) conducts and the binary output level at the collector of the non-conducting transistor is -6 volts ("-" level) for PNP type decades. In the "0" state, the opposite condition exists and the output is 0 volts ("+" level). In the simplified diagram of Figure 3, the shaded areas indicate which transistors in the decade are conducting at the reset condition. The binary logic is 0-0-0-0, which is equivalent to a coded "0".

The first three binaries have dual mode triggering through the parallel input steering diode connections and therefore change from one state to another on receiving successive positive pulses from the preceding stage or decade input. In dual mode triggering, one steering diode is cutoff by the -6 volts at the collector of the non-conducting transistor. The positive input pulse passes through the other steering diode and cuts off the conducting transistor. The following positive pulse will not pass through the same diode because of the reversal of biasing. Binary A alternates with every input pulse or "count", Binary B with every second count (when not inhibited), and Binary C with every fourth count. Binary D has two single-mode trigger inputs: a) the positive output of Binary A being coupled to the odd-numbered transistor, will cause it to trigger to the "0" state only; b) similarly, the positive output of Binary C, being coupled to the even-numbered transistor, will cause it to trigger to the "1" state only. A third special condition exists at the input to Binary B; c) Feedback from the output of Binary D through R137 and the normal input through C111 form an AND gate. A positive input will pass only if the output of Binary D is positive. On counts 8 and 9, the output is negative, which prevents the next positive pulse from passing through the gate. Therefore, Binary B is inhibited from

triggering at count "0". The complete sequence of events is shown in Figure 4. The arrows in the illustration indicate the triggering modes discussed above. The output polarity is inverted through Q122 to provide the correct polarity to operate the following NPN type decade unit.

The 2.5MC decade departs from the basic scheme described above in the following manner. In order to reduce capacitive loading which causes distortion of the squarewave needed for triggering at the high frequencies, an emitter follower stage, Q115, is inserted at the output of Binary A. For the same reason single-mode triggering is used for Binary C. Binary B output, therefore triggers Binary C to the "1" state on count 4 by coupling through C115 to Q119. Binary C is triggered back to the "0" state by the $\bar{B}$, or reverse output of Binary B and the emitter follower output being coupled through an AND gate to Q118. (CR114 and C116 paths).

Gate Circuit The gate circuit consists of Q101, Q102, and Q103, which form a circuit almost identical to the Pulse Selector Gate. The "count" input signal passes through Q101 and Q103 when the gate switch Q102 is off. This occurs during the interval when the Gate level input is high (0 volts) after the occurrence of a start signal. When the gate level drops to -6 volts after the occurrence of a stop signal, Q102 saturates, grounding out the "count" signal at its collector.

Bi-Quinary Drive Circuit Bi-quinary circuit logic is used in the indicator drive circuit associated with each decade counting unit in the Counter. The circuit consists of a binary stage which alternately energizes the even-numbered and odd-numbered anodes in the indicator with successive input pulses, and a "scale of five" circuit consisting of five transistors which turn on successively for a duration of two input pulses or "counts". Each of the 5 transistors control an odd and an even-numbered cathode in the indicator in the sequence of 0-1, 2-3, 4-5, 6-7, 8-9. The combined action of the binary and quinary circuits, therefore, produces the desired scale of 10.

The bi-quinary circuit is driven by the output voltages of the "8421" binaries of the basic decade unit. The "1's" or A binary of the decade drives the two transistors in the binary section of the bi-quinary circuit directly (Q104 and Q105). These turn on and off corresponding drivers Q106 and Q107 which ignite the indicator anodes. The quinary section is driven by the B, C, and D binaries, the normal outputs of which form a scale of 5 as shown in Table I.

Each transistor in the quinary section is controlled by "and" gate logic. If all inputs are 0 volts (equivalent to a logical 0), the transistor will turn on and cause the corresponding even or odd indicator numeral to energize. If one input is -6 volts (equivalent to logical "1") the transistor will turn off. The input connections for each transistor in the quinary section can be deduced from Table I. Where a "0" occurs in the code for a particular numeral, the normal output from the binary is used: B_o, C_o and D_o. Where "1" occurs in the code, this is transformed to a "0" to satisfy the necessary input condition for "on" state by employing the alternate output of opposite phase of each binary; B_1, C_1 and D_1. Table II shows the actual input connection scheme, which eliminates redundant combinations.

TABLE I
Scale of 5

Count	Binary Output Code		
	D_o	C_o	B_o
0,1	0	0	0
2,3	0	0	1
4,5	0	1	0
6,7	0	1	1
8,9	1	0	0

TABLE II
Circuit Connections

Transistor	Input Connections		
Q108	D_o	C_o	B_o
Q109		C_o	B_1
Q110		C_1	B_o
Q111		C_1	B_1
Q518	D_1		

250KC Decade

The logic and circuitry of the decade binaries are essentially the same as that of the 2.5MC circuit, except that NPN type transistors are used which require opposite bias polarities. In the bi-quinary drive circuitry, the connections to the binary outputs have been reversed, also, to provide the proper polarity. Because of the lower speed of operation, most of the diodes in this circuitry have been eliminated. The "Carry" output of the decade is taken directly from the collector of the final transistor, being of the correct polarity to drive the following NPN decade.

4.6 RANGE INDICATOR

The range indicator unit (#11 in Dwg. 63E866840) contains a single flip-flop (Q101, Q105) and indicator driver stage (Q102-Q106). The circuitry is equivalent to the first binary stage only of one of the decade units which control the even-odd anodes of the bi-quinary indicator. In positions 2 and 3 of the Range Selector switch, none of the cathodes of the indicator can energize and the indicator is dark. In the 100MC range, the 0-or 1 cathode can energize, depending on whether a "count" pulse is received by the binary stage. In the Extender position, either the 0 or 1, or the 4 or 5 cathodes can energize, according to the position of the Extender range switch (105 to 175MC, or 405 to 470MC).

4.7 POWER SUPPLY

The power supply furnishes the following output voltages:

Voltage	Current	Use
+30V	500ma	Transistor biasing
-30V	500ma	Transistor biasing
+ 6V	500ma	Transistor biasing
- 6V	500ma	Transistor biasing
+225	50ma	Indicator tube B+
+43V	5ma	Indicator tube biasing
+20V	10ma	Heterodyne unit
-15V	50ma	Heterodyne unit

The +30V and -30V outputs are obtained from individual voltage regular sections, while the +6V and -6V outputs are obtained from a common regulator section. Using the -30V section as an illustration, a full-wave diode rectifier (CR11 and CR12) generates an unregulated 40 volts which is applied to an "L" filter consisting of R5 and C5. The filtered DC passes through a series regulator (Q5), a type 2N1546 transistor, to the output terminal. The regulator is controlled by degenerative feedback from the regulating amplifier, Q106 and Q107, and acts as a variable impedance device which compensates for changes in output voltage level. At a stable condition, the voltage at the arm of R131 in the output divider network is virtually zero with respect to the fixed bias level at the emitter of Q106 created by Zener diode CR105, which is the prime reference for the supply. When the output level drifts, an error voltage at the arm of R131 is sensed by the regulating amplifier. The degenerative loop action of the amplifier tends to reduce the error voltage to zero again. The output voltage level can be varied by changing the setting of R131. Output regulation is maintained to within 2%.

The -30V power supply is identical except that the circuit is grounded at the low side, which shifts the high side to a +30V level.

In the +6V and -6V supplies, Q3 and Q4 are the series regulators and Q104 and Q105 are the corresponding amplifiers. Regulation is dependent, not upon +6V and -6V outputs but upon the +30V and -30V outputs applied to the amplifiers through R115 and R121 respectively. The fixed-bias reference for each of these amplifiers is provided by the voltage across Zener diodes CR103 and CR104.

The +225V output is generated by a bridge type rectifier circuit (CR1 through CR4) having a low power type 2N375 series regulator transistor, Q1 which is controlled by a single-stage-amplifier, Q101. The -30V regulated output applied to R103 in the divider network is the prime reference for this circuit.

The +43V output is generated by a type IN716 13-volt Zener diode, CR101, connected across the 30V and 225V outputs.

Blanking Circuit. The indicator tubes may, at the operator's wish, be blanked-out during the count cycle so that an indication is obtained only after the final count is registered. Blanking is accomplished when Q109 is turned off and a +15V is applied to the blanking line to each decade unit. This positive voltage turns on both transistors in the binary section of the biquinary drive circuit (Q400, Q401, Q500, Q501, etc.) which turn off the following switch transistors, removing B+ from the indicator tubes. The blanking gate consists of inputs through diode CR106 and resistors R133 and R134. When any of these inputs is connected to +6V or greater, transistor Q108 will turn off and transistor Q109 will turn on to prevent blanking. Thus, if the blanking switch is in the "off" position, or the Function switch is in the Count or Hold mode, no blanking will occur. With blanking on, the end of count signal input from the Display and Reset module will control blanking. At reset and during the count cycle, this input is 0 volts and and blanking takes place, since Q108 is on. After the "stop" pulse, a +6V end of-count signal level occurs which removes blanking.

4.8 HETERODYNE UNIT

Principle of Operation: The standard extender unit generates both a 100 megacycle and a 400 megacycle per second harmonic derived from the 1 megacycle time base oscillator. The incoming signal is mixed with the appropriate harmonic, as selected by the front panel range switch, and a difference frequency is produced in the range of 0 to 100 megacycles per second. The difference frequency is amplified and then applied to the main frequency meter circuitry for direct measurement according to the principles already discussed in paragraph 1.3.

105-175MC Input Circuit. CR101 and associated components mix the 100Mc multiplier signal and the incoming signal in the range of 105 to 175Mc. The difference frequency in the range of 5Mc to 75Mc first passes through an 100Mc notch filter which removes any residual 100Mc frequency component that otherwise may appear in the output. The signal is then amplified by a four-stage (Q101 to Q104) wide-band amplifier which provides essentially flat response from 2Mc to 85Mc. A 60 millivolt peak-to-peak input signal should produce a 250 millivolt peak-to-peak signal at the output of the amplifier. A tunable 100Mc trap (L119 and C172) filters any remaining 100Mc component at the output.

405-475Mc Input Circuit. Diode CR103 generates a series of 100Mc harmonics of the basic output frequency of the multiplier section. These frequencies are injected into the coax tuner assembly which is tuned to the 400Mc harmonic. The 400Mc signal is picked up by the output loop of the tuner assembly and mixed with the incoming signal from the 405-475Mc input terminals by means of mixer diode CR102. The difference frequency (5 to 75Mc) is then applied directly to the wide-band amplifier since no 100Mc filtering is required.

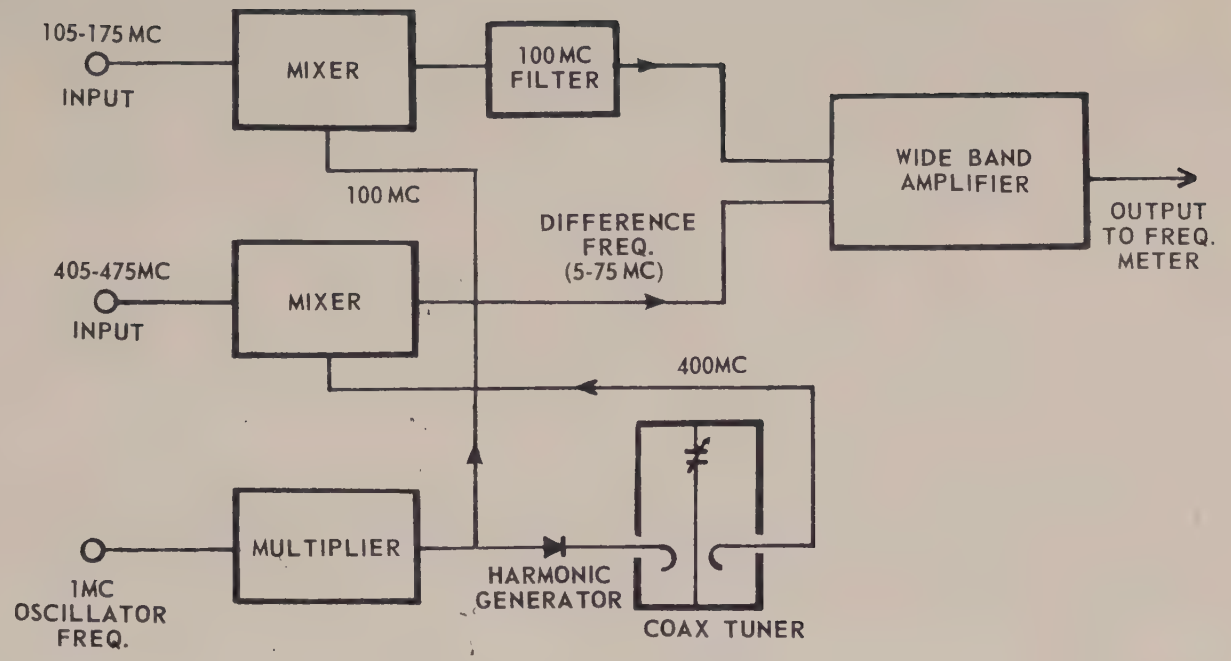


FIGURE 5. Heterodyne Unit Block Diagram

5—Maintenance and Servicing

5.1 GENERAL TROUBLE SYMPTOM GUIDE

The following trouble symptom guide will assist in locating quickly a mal-functioning circuit. Detailed information on the individual circuits, including waveforms, is given in the referenced circuit descriptions.

The Calibration and Adjustment Procedures, given in Section 5.8, constitute a thorough and systematic trouble-shooting procedure.

GENERAL TROUBLE SYMPTOM GUIDE

Trouble	Cause
Indicators are illuminated but do not count	Refer to Input Amplifier, Time Base and Control Binaries circuit sections. Check Function Switch.
Indicators start counting and reset, but do not stop.	Check "stop" section of control binaries. Check Gate in 2.5 MC Decade.
No automatic reset	Refer to Display and Reset circuit section.
One indicator counts erratically; other sequence normally . .	Refer to Decade trouble guide; fault is in bi-quinary drive section or in indicator.
One indicator counts erratically or not at all; following tubes do not count	Refer to Decade trouble guide; fault is in binary section.
TEST function count indications are incorrect	Refer to Time Base trouble guide.

5.2 CONTROL CIRCUIT SERVICING GUIDE

When servicing the Display and Reset board, first confirm that start and stop pulses are available from the time base at input terminals H and 4. If no gate level signal at terminal F (P301) occurs with start and stop pulses applied, check transistors Q301 through Q304 and diodes CR301 through CR307 and CR309. Make a methodical check for presence of all output signals represented by the waveforms in Figure 2. If the Bi-quinary section is mal-functioning, refer to the Decade circuit description and trouble symptom guide.

5.3 TIME BASE SERVICING GUIDE

Trouble Symptom	*Cause*
a. No time base output frequency, Oscillator all right.	Pulse Selector Gate inoperative. Look for 1cps time base frequencies at pin 8 of P200. Circuit trace starting at 1MC shaper input.
b. Inaccurate measurement of 1MC TEST frequency (off by 10%).	One divider circuit not correctly adjusted. Refer to Time Base Adjustment (5.8).
c. Some time base frequencies are not present at Time Base Output terminals (P200): 1MC at pin 1, 100KC at pin 4, etc. (Refer to schematic 9636).	Check unijunction transistor, diode, or other component in divider circuit for highest of these frequencies.
d. Output of 10KC instead of 1 cps.	One-Shot Pulse selector inoperative (Q218, Q219, Q220).

5.4 DECADE UNIT SERVICING GUIDE

The following trouble-shooting guide refers to circuit detail numbers in the 2.5MC decade. By transposing the transistor reference numbers, it may also be applied to the 250KC. The symptoms may occur somewhat less predictably than presented in the table.

A transistor may not conduct, for example, because it is open, the complementary transistor is leaky, or the associated steering diode is open.

TROUBLE SYMPTOM GUIDE FOR DECADE UNITS

(Detail Numbers refer to 2.5 MC decade.)

Symptom	Cause
a. Counts even numbers only	Q104 or Q107 not conducting
b. Counts odd numbers only	Q105 or Q106 not conducting
c. Holds on any even number	Q113 not conducting
d. Holds on any odd number	Q114 not conducting
e. Alternates between 0 and 1	Q116 not conducting
f. Alternates between 2 and 3 . . . . . See "g" and "h" below.	Q117 not conducting
g. Cycles: 0-1-2-3, or alternates: 2 & 3	Q118 not conducting
h. Cycles: 4-5-6-7, or alternates: 6 & 7 . . . . (See "i" below).	Q119 not conducting
i. Cycles: 0 through 7, or alternates: 2 & 3 or 6 & 7	Q120 not conducting
j. Alternates with dual illumination: 8 2 and 3 9	Q121 not conducting
k. Two numbers indicate simultaneously . . .	Leaky bi-quinary drive transistor related to numeral which is out of sequence. (Q108-Q112)

5.5 RANGE INDICATOR TROUBLE SYMPTOM GUIDE

Non-functioning of the range indicator circuitry will be evidenced as an erroneous first digit indication. Normally, no other circuitry will be affected. The trouble symptoms and causes will be identical to those produced by a malfunctioning first stage binary in a decade unit.

5.6 POWER SUPPLY TROUBLE SYMPTOM GUIDE

(Component Schematic Reference numbers apply to -30V section only.)

Symptom	Cause
Voltage not regulated, may oscillate slowly.	Zener reference diode CR105, open
Voltage varies with line voltage or load change.	Loss of gain in regulator transistors, Q106 or Q107.
Excessive ripple, high output.	Defective Zener diode, CR105.
	Filter capacitor open, C5.
Excessive ripple, low output.	Diode rectifier, CR11 or CR12 open.
Output cannot be adjusted.	Regulator transistor open Q106, Q107.
No output, one section.	Fuse or series control transistor 2N1546 open.
	Transformer secondary winding open (Check unregulated d.c. or a.c.)
No output, all sections.	Transformer primary open

5.7 HETERODYNE UNIT TROUBLE-SHOOTING GUIDE

Symptom	Cause
Both channels not operating, 10KC to 100KC Range all right.	Check multiplier and wide-band amplifier. (See Heterodyne Unit Alignment and Test Procedure).
105-175MC Range only detective.	Diode mixer CR101* or associated components bad. Also filter network L101-L104, C104-C110.
405-475MC range only detective.	Harmonic generator diode CR103* Coax Tuner Assembly. Mixer diode CR102.*
Counts 100 MC with no input in 105-175MC range.	Output 100MC trap (L119, C179) or 100MC filter (L101-L104, C104-C110).
2 Volt input OK, 15V not.	R101 (R142) open.

* See 5.10 for replacement procedure.

MOTOROLA DIGITAL FREQ METER
AF S1075A

5.8 GENERAL CALIBRATION AND TEST PROCEDURE

A. *Test Equipment Required*

To perform the trouble-shooting and maintenance tests described in this manual, the following test equipment is recommended:

1. Oscilloscope, 15MC bandwidth (Tektronix Model 531 with Type C plug-in amplifier or equivalent.)
2. Oscilloscope, 100MCs bandwidth (Lumatron Electronics Model 120 or equivalent.)
3. Signal generator, 0-50MC sine-wave, (General Radio Model 1330A or equivalent.)
4. Signal generator, VHF. 10MCs to 500MCs sine-wave (Hewlett-Packard Model 608C or equivalent).
5. Signal generator, 0-1000 cps sine-wave, (Systron-Donner Model 1202 or equivalent).
6. Squarewave generator, 0.1 MC output (Hewlett Packard Model 211A or equivalent).
7. Volt-ohmmeter, Simpson Model 260 or equivalent.
8. Variable line voltage transformer (''Variac'').
9. Standard frequency source.
10. Extension cards for plug-in modules (See Accessories on page 39.)

B. *Tests*

Routine performance of the following tests will assure that the Model S1075A is operating within its rated specifications.

NOTE: Remove the chassis from the case to gain access to all test points and adjustments. (Remove the six outside screws at the rear of the instrument which attach the case to the chassis.)

1. Preliminary: Turn on AC power. Look for symptoms of over-heating in the power supply. Note that the fan operates. If trouble is observed, turn off AC power and remove all plug-in circuit cards. Measure resistance to ground at the terminals of P102: (V = -30V, W = +30V, R = -6V, T = +6V, 6 = +43V, All should measure greater than 100K ohms.

2. Power Supply Adjustments:
   (Refer to Figure for adjustment locations)
   (a) Measure the voltage at the -30V bus and adjust R131 on the regulator card for a reading of -30.0 volts. Repeat the measurement at the +30V bus and adjust R112 for the correct reading of +30.0 volts.
   (b) Measure the +6V output and adjust R164 for a reading of 6.0 volts. Measure the -6V output and adjust R120 for -6V ±1%. (All other voltages may be adjusted to ±3%.)
   (c) Measure the +225V and adjust R102 for a nominal of +225V.
   (d) Check the +43V output (no adjustment).

3. Make a quick self-check as follows.
   (a) Place the FUNCTION selector at TEST. Observe that the count indication is 1,000,000 cps. (Tolerance = ±1 count).

4. Oscillator Adjustment.

Adjustment of the oscillator requires a highly accurate frequency standard which is not generally available in the field. For this reason, it is recommended to return the oscillator unit to Motorola for re-calibration at 12 to 18 month intervals.

5. Input Amplifier Check
   A. Low Frequency Amplifier
   1. Set function switch to 10cps-10Kc, 1 cps resolution.
   2. Turn on power and apply a 10kc, 100mv peak-to-peak input signal.
   3. Connect scope input to collector of Q128 and observe that symmetrical square wave appears. If not symmetrical, substitute a new value for R190.
   4. Look for identical waveform at pin H or 7

   B. 100MC Amplifier and Ring Counter
   1. Set function switch to 10kc-100MC position.
   2. Apply a 10Mc, 100mv peak-peak input signal.
   3. Adjust R145 for a symmetrical waveform at the collector of Q105.
   4. Change scope to collector of Q110. The output swing should be approximately +1.5V to 2.5V.
   5. Observe output of ring counter at collector of Q115. The signal should be 2Mc at approximately 0.75 volts amplitude.
   6. If the ring output is 10Mc, install or change value of R204 (approximately 470 ohms).
   7. Check that output at pin C is 500Kc.

   C. Meter Circuit Check
   1. Apply a 100mv input signal in the 10KC-100Mc range. The input meter should read on the lower red green dividing line ±10%.
   2. Apply a 2V signal. The input meter should now read on the upper red/green dividing line ±10%.
   3. If results for steps 1 and 2 are not good, select new value of R150* (by temporarily replacing with a potentiometer) so that the meter level indicates 0 when no input signal is applied. Check results after new resistor is installed.

   * 5.6K nominal value

   D. Check proper operation of input amplifier and meter circuit throughout the frequency range from 10Kc to 100Mc with both 100mv and 2V input levels.

6. Sensitivity and Frequency Range:
   (a) Apply a 100MC sinewave signal of 0.3 volts peak-to-peak amplitude to the input. The Model S1075A should cycle continuously and register a count of approximately 100.0000 Mcs.

7. Power Supply Ripple and Noise:
   Monitor the voltages at all of the fuses on the power supply assembly (mounted on the transformer) with the oscilloscope. Note that the ripple frequency is 120 cps, not 60 cps.

   Ripple must not exceed 0.5V peak-to-peak and noise must not exceed 200mv peak-to-peak on any bus.

8. Power Supply Regulation:
   (a) Connect the Variac in the AC power input to the Model S1075A and reduce the line voltage to 100V. Repeat step 3 in part to confirm operation and re-check ripple and noise as in step 7.
   (b) Change the input line voltage to 130V and repeat step 8a for the identical requirements.

9. Time Base Adjustment Procedure
(Refer to Time Base Assembly illustration for component locations).

100KC Adjust:

a. Mount the Time Base Module using the extension cards. Apply the output of the 1 megacycle standard to the module input terminal (P201-L).

b. Attach the scope input lead to terminal P200-1 of the Time Base module and observe a 1MC negative-going squarewave with amplitude of 6 volts peak-to-peak.

c. Change scope input to P200-4. Vary potentiometer R224 and note that the number of pulses appearing on the scope changes to 8 at one extreme and to 12 at the other. If necessary, select another value for R223 to produce the correct results. Set R224 to the midpoint of the range in which only 10 pulses occur.

10KC Adjust:

Change the scope input lead to P200-6. Vary potentiometer R240 and note that the number of pulses appearing on the scope changes to 9 at one extreme and 11 at the other. If necessary, re-select R241. Set R240 to the midpoint of the range in which only 10 pulses occur.

1KC, 100, 10 and 1 CPS Adjustments:

Repeat the steps given under 10 KC Adjust for the 1 KC, 100 cps, 10 cps and 1 cps adjustments. Refer to the table below for the corresponding test points and components for each adjustment.

Pulse Selector Waveshape:

Connect the scope to the junction of R281 and the adjacent diode and change to a 200 μsec sweep rate and measure the width of one pulse. The pulse should be 140 ± 20 microseconds wide.

Time Base Output:

Connect the scope to pin 7 of P200 and observe that the time base output frequency is present.

TABLE FOR TIME BASE ADJUSTMENTS

Time Base Output	Adjust	Select Resistor	Test Point	Scope Sweep
1 kc	R247	R248	P200-B	10 msec
100 cps	R254	R255	P200-C	100 msec
10 cps	R261	R262	P200-5	1 sec
1 cps	R268	R269	P200-D	10 sec

5.9 HETERODYNE UNIT ALIGNMENT AND TEST PROCEDURE

A. *Equipment Required*

1. Oscilloscope Tektronics, Type 581 or equivalent.
2. DC voltmeter: Simpson 260 or equivalent.
3. H-P Signal Generator 608C (500 Mc)
4. 50 ohm terminator for BNC connector.

B. *Multiplier Alignment Procedure*

(Refer to Figures 18 and 19 for testpoint and component locations.)

1. Connect the oscilloscope to the 5MC test point. Adjust L109 and L110 for maximum Scope deflection (approximately 2.0v p-p) at 5 Mc (.2μ sec period).
2. Move oscilloscope lead to the 25 Mc testpoint and adjust L111 and L114 for maximum scope deflection (approximately 2v p-p) at 25 Mc.
3. Move oscilloscope lead to 50 Mc test point marked 50 Mc and adjust L116 and C170 for peak signal amplitude (approximately 2.0v p-p) at 50 Mc.
4. Connect negative lead of voltmeter (10v Scale) to testpoint "H" and connect positive lead to ground with heterodyne switch at 405-475Mc, adjust L118 and L119 for maximum reading (approximately 2.5 volts).
5. Set up equipment as illustrated in Fig. 6. Adjust signal generator to approximately 410 Mc at approximately 100 millivolts p-p.
6. Tune the 400 Mc adjustment on the coax tuner for a maximum scope display of approximately 10 Mc.
7. A. Reduce signal generator output to zero. Observe noise signal on scope.
   B. Tune 100 Mc trap on amplifier board (C172) for minimum scope amplitude. Reading should be below 30 millivolts p-p.
8. Switch to 105-175 Mc position and observe scope amplitude. Reading should be below 30 millivolts p-p.

C. *Final Check*

Use Set Up in Figure 7.

1. Set selector switch to 105-175 Mc position.
2. Inject signal with generator set to approximately 70 millivolts. Tune from 105 to 175 Mc and observe that counter readings correspond to input frequencies.
3. Reduce generator output to zero and check for zero reading on counter.
4. Switch input to 405-475 Mc channel and set selector switch to the 405-475 Mc.
5. Inject signal with generator set to approximately 70 millivolts and tune from 405-475 Mc. Observe that counter readings correspond to input frequencies.
6. Repeat Step 3.
7. Inject generator signal to the 105 Mc high level input connector.
8. Adjust the generator output to one volt RMS output and check as in Steps 1 and 2.
9. Move the generator signal to the 405 Mc high level input connector.
10. Adjust the generator output to one volt RMS out and check as in Step 5 with selector at 405-475 Mc.

5.10 *Disassembly of the Heterodyne Unit*

To replace components, remove the circuit boards from the heterodyne assembly by the following procedure. For testing, only step one is necessary.

1. Remove the two screws at the rear which attach each of the side covers and slide these panels out.
2. Remove the four rear screws which attach the rear connector bracket.
3. Remove the three screws which attach each PC board to the frame.
4. Remove the three screws which attach each extruded "U" channel frame piece to the front panel.
5. Hold the circuit board and slide out the "U" channel, taking care not to break any wires.

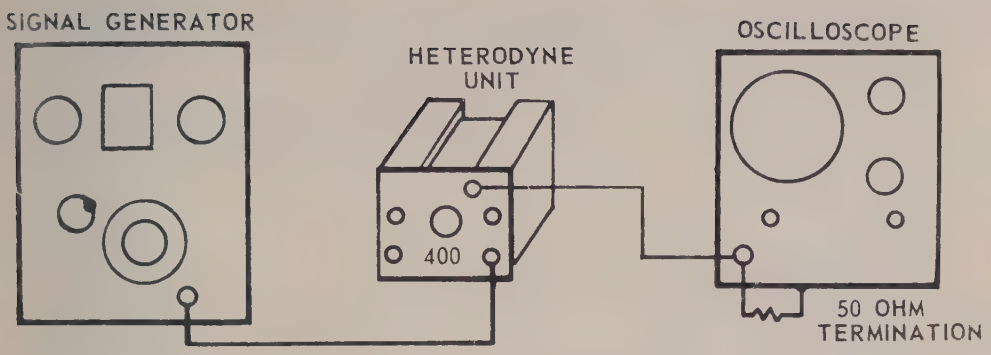


FIGURE 6. Heterodyne Unit Adjustment Circuit

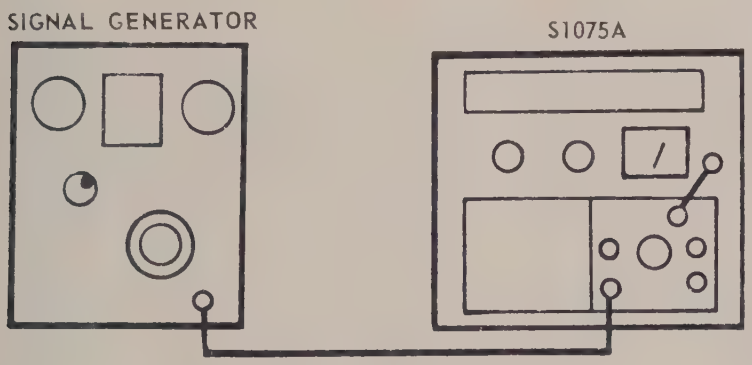


FIGURE 7. Heterodyne Unit Test Circuit

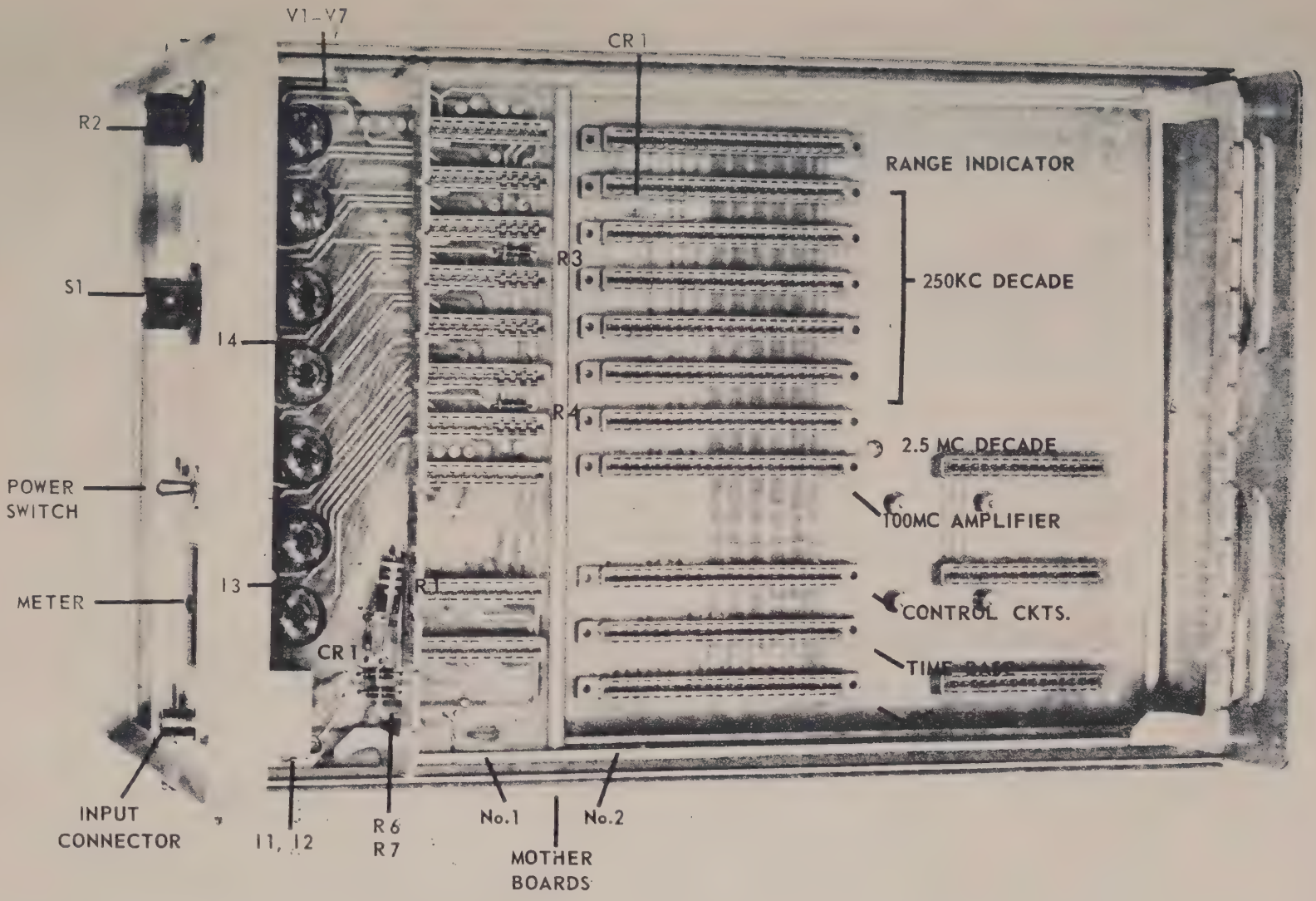


FIGURE 8 – CHASSIS ASSEMBLY, TOP VIEW
Showing Location of Major Components

PARTS LIST – Chassis Assembly and Front Panel Components

MAJOR COMPONENTS	Motorola Part No.
Power Supply Board	1P83193A20
Time Base Board	1P83193A21
Control Circuits Board	1P83193A22
100MC Amplifier & Prescaler	1P83193A23
2.5MC Decade & Gate	1P83193A24
250KC Decade	1P83193A25
Range Indicator Board	1P83193A26
Oscillator	S1072A-ASP03

FRONT PANEL

R2 (Display)	18P83192A71
S1 (Function)	40P83192A67
Power Switch	40P83192A70
Input Connector	9P83192A69
Level Meter	72P83192A68

MOTHER BOARD NO. 1

R1	06S10053G83
R3, R4	06S10053C20
R6, R7	6R5559
R8, R9*	6K131524
CR1	48P83192A85
V1, V7	ZM1030
I1, I2	65K868606
I3, I4	65P83192A76

MOTHER BOARD NO. 2

CR1	48P83192A09

*Located on under side

Refer to Master Parts Description on page 39 for Part Descriptions and Listing of miscellaneous hardware.

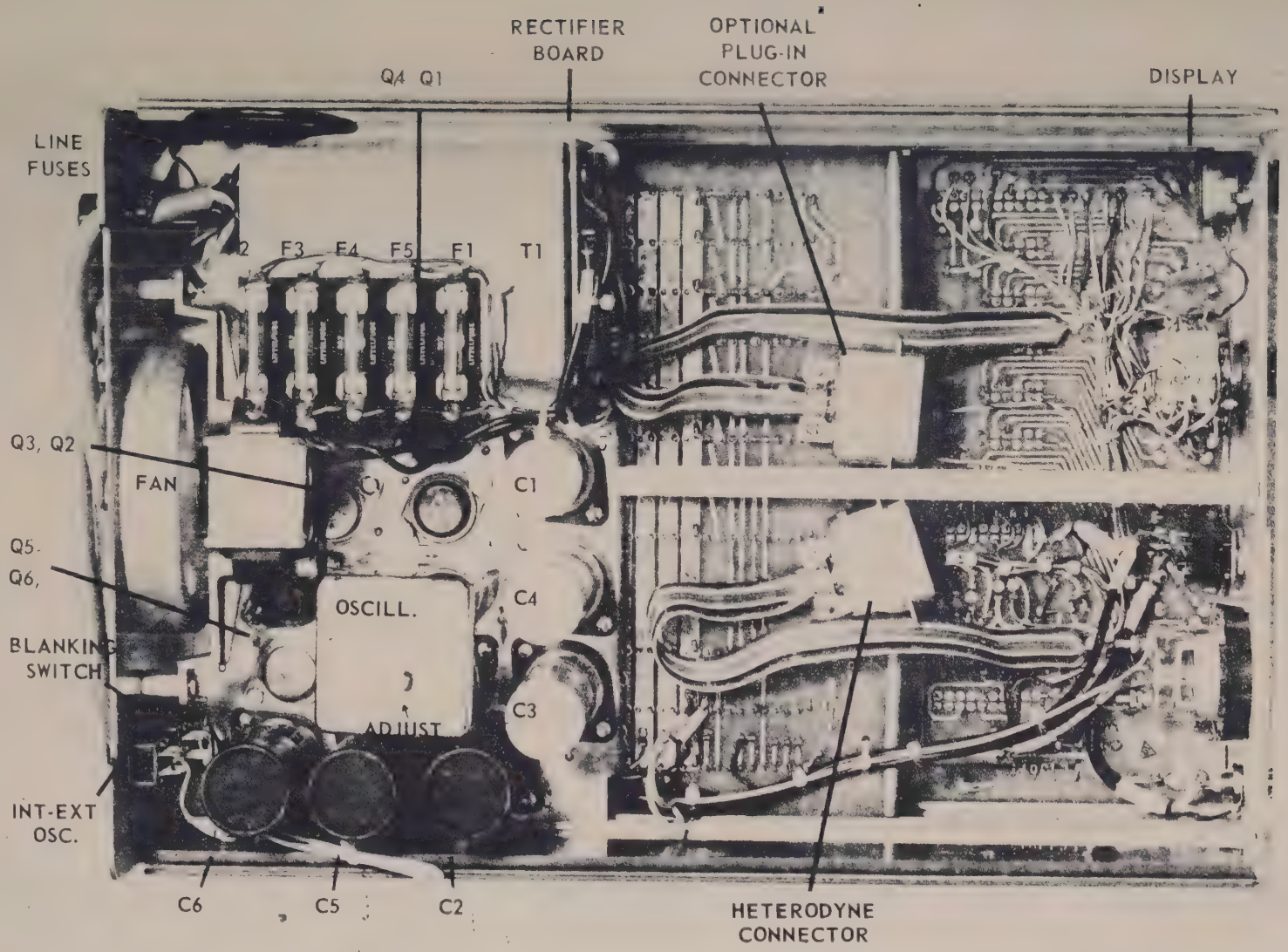
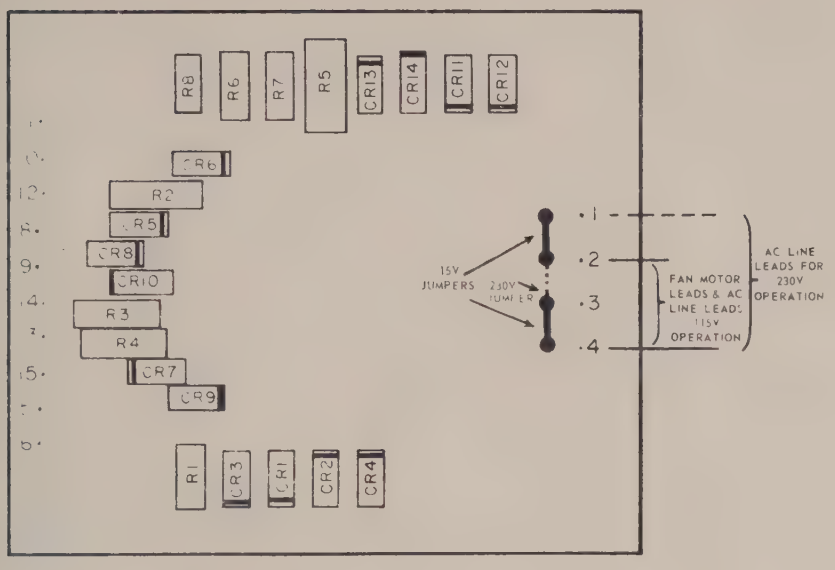


FIGURE 9 – CHASSIS ASSEMBLY, BOTTOM VIEW
With Power Supply Assembly

FIGURE 10 – POWER SUPPLY RECTIFIER COMPONENTS



PARTS LIST – Power Supply and Rear Panel Components

CAPACITORS

Ref.	Motorola Part No.
C1	23P83193A57
C2	23P83193A56
C3	23P83193A56
C4	23P83193A56
C5	23P83193A56
C6	23P83193A56

TRANSFORMER

T1	25P83192A63

DIODES

CR1	48P83192A84
CR2	48P83192A84
CR3	48P83192A84
CR4	48P83192A84
CR5	48P83192A85
CR6	48P83192A85
CR7	48P83192A85
CR8	48P83192A85
CR9	48P83192A85
CR10	48P83192A85
CR11	48P83192A85
CR12	48P83192A85
CR13	48P83192A85
CR14	48P83192A85

FUSES

Ref.	Motorola Part No.
F1	65K802992
F2	65K804910
F3	65K804910
F4	65K804910
F5	65K804910

TRANSISTORS

Q1	48P83193A74
Q2	48P83193A75
Q3	48P83193A65
Q4	48P83192A62
Q5	48P83193A75
Q6	48P83193A65

RESISTORS

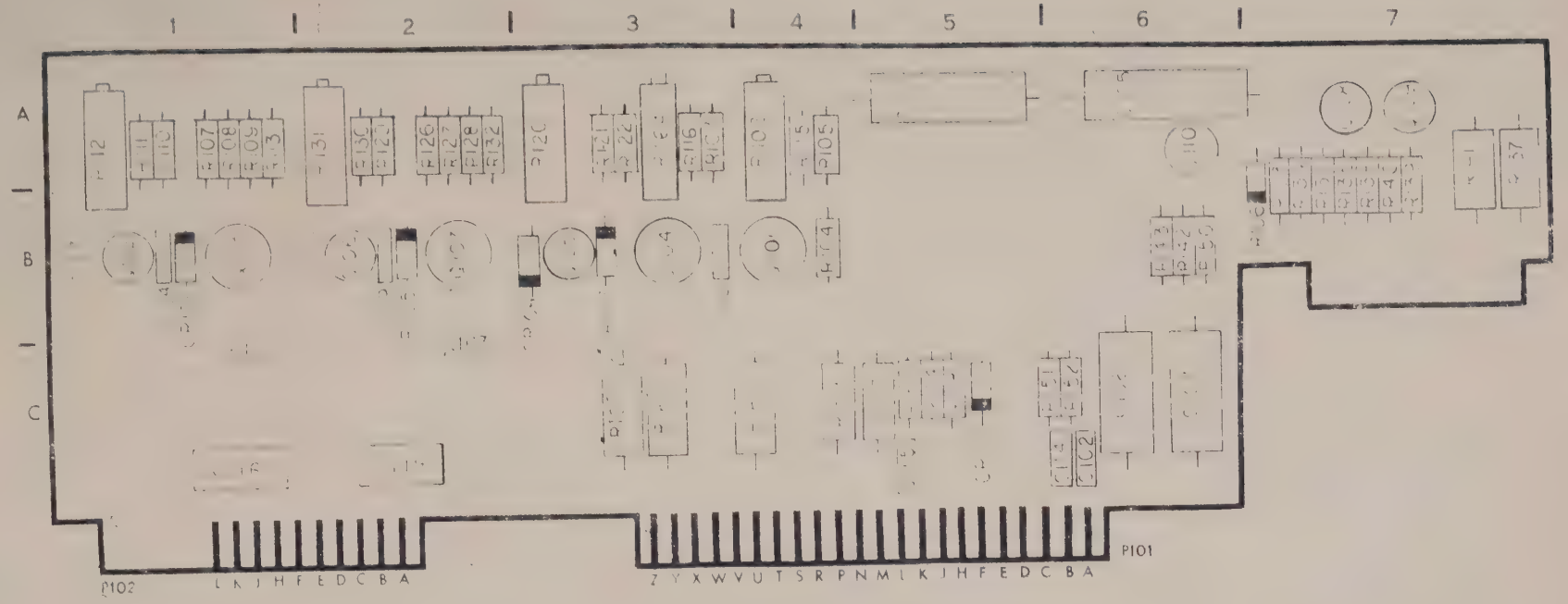
R1	6R114018
R2-R7	17P83193A40
R8	6S125A32
R9	6R114154

REAR PANEL

AC Line Cord	30P83192A81
Fan Assembly	1P83192A82
Fuse Holder	9C82083C02
Connector	9P83192A69
Switches	40P83192A83
Fuses	65R890033

Refer to Master Parts Description on page 39.

FIGURE 11 ' POWER SUPPLY REGULATOR CIRCUIT BOARD ASSEMBLY



Refer to Master Parts Description on page 39.

CAPACITORS

Ref.	Index	Motorola Part No.
C101	B3	21P83193A01
C102	C6	21P83192A08
C104	B1	21P83192A08
C105	A6	23P83193A54
C106	C6	23P83193A53
C107	C6	23P83193A53
C109	B2	21P83192A08
C110	A5	23P83193A54
C114	C6	21P83192A08
C115	C5	21P83192A08
C116	C1	8P83193A48
C117	B1	21P83193A73
C118	B1	21P83193A73
C119	C2	8P83193A48

DIODES

CR101	C5	48P83193A60
CR102	B1	48P83193A60
CR103	B3	48P83193A59
CR104	B3	48C82256C15
CR105	B2	48P83193A60
CR106	B7	48P83192A09

TRANSISTORS

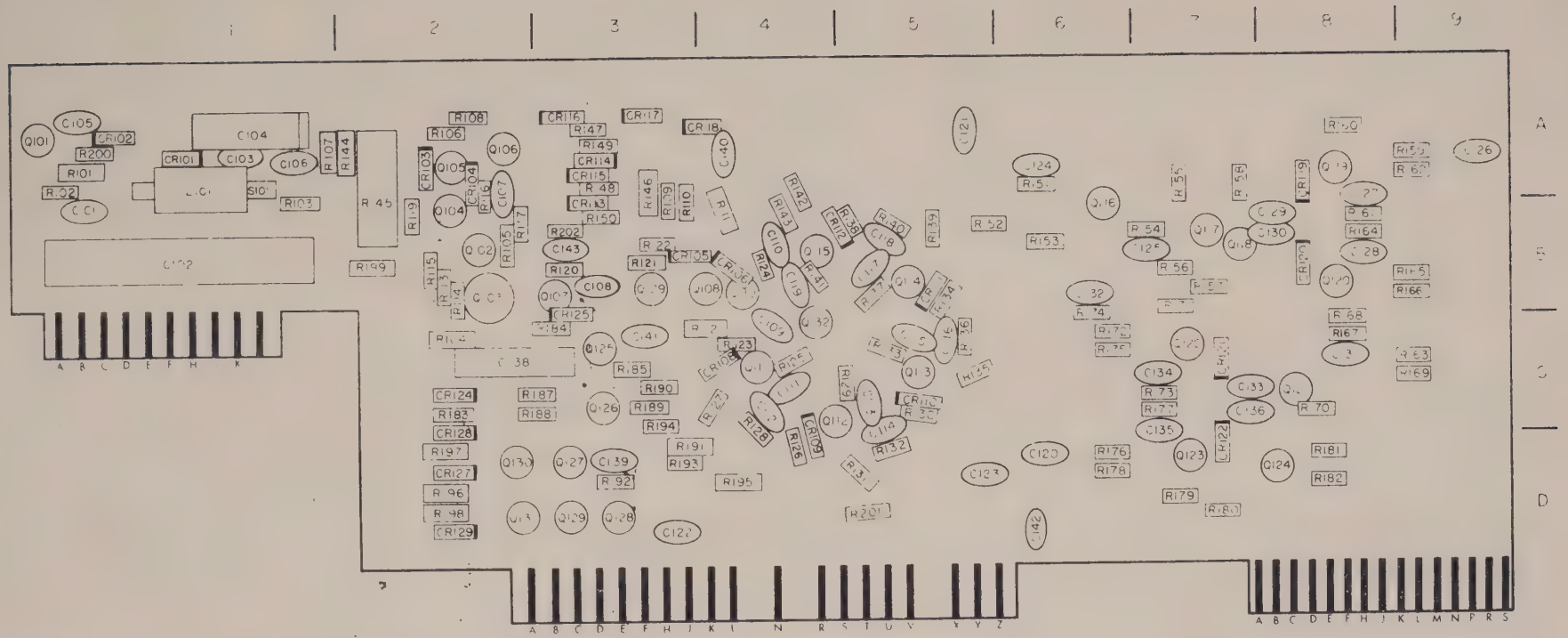
Ref.	Index	Motorola Part No.
Q101	B4	48P83193A62
Q102	B1	48A134525
Q103	B1	48P83193A62
Q104	B3	48P83193A62
Q105	B3	48P83193A63
Q106	B2	48A134525
Q107	B2	48P83193A62
Q108	A7	48P83192A41
Q109	A7	48P83192A14
Q110	A6	48P83192A41

RESISTORS

Ref.	Index	Motorola Part No.
R101	C3	06S10053G83
R102	A4	18P83193A33
R103	A3	6R2003
R104	B4	6R400057
R105	A4	6R119172
R107	A1	6R3940
R108	A1	6R3940
R109	A1	6R6408
R110	A1	6R3940
R111	A1	6R2028
R112	A1	18P83193A33
R113	A1	6R2024
R115	A4	6R5652
R116	A3	17P83192A72
R118	C5	6R400058
R120	A3	18P83193A41
R121	A3	6R2003
R122	A3	6R400058
R124	C5	6R400058
R126	A2	6R3940
R127	A2	6R3940
R128	A2	6R6408
R129	A2	6R3940
R130	A2	6R2028
R131	A2	18P83193A33
R132	A2	6R2024
R133	B7	6R2001
R134	B7	6R2001
R135	B7	6R6411
R136	B7	6R400490
R137	B7	6R3925
R138	B7	6R2049
R139	B7	6R5553
R140	B7	6R5556
R141	B7	6R488051
R142	B6	6R3940
R143	B6	6R5772
R150	B6	6R2049
R151	C6	06S10053C72
R152	C6	6R5559
R157	C5	06S10053E06
R158	C5	6R2024
R159	C4	06S10053E12
R160	C4	06S10053G32
R161	C3	6R488187
R162	B1	6R3940
R163	B2	6R3940
R164	A3	18P83193A41

F

FIGURE 12 – 100 MC AMPLIFIER AND PRESCALER BOARD



Refer to Master Parts Description on page 39.

CAPACITORS

Ref.	Index	Motorola Part No.
C101	A1	21P83193A43
C102	B1	8P83193A58
C103	A1	21P83192A02
C104	A1	8P83193A49
C105	A1	21P83193A45
C106	A1	21P83192A02
C107	A2	21P83193A46
C108	B3	21P83192A18
C109	C4	21P83193A42
C110	B4	21P83192A04
C111	C4	21P83192A04
C112	C4	21P83192A04
C113	C5	21P83192A04
C114	C5	21P83192A04
C115	C5	21P83192A04
C116	C5	21P83192A04
C117	B5	21P83192A04
C118	B5	21P83192A04
C119	B4	21P83192A04
C120	D6	21P83193A45
C121	A5	21P83192A08
C122	D3	21P83192A08
C123	D5	21P83193A45
C124	A6	21P83193A46
C125	B7	21P83193A46
C126	A9	21P83193A45
C127	A8	21P83192A19
C128	B8	21P83192A19
C129	B8	21P83193A46
C130	B8	21P83193A46
C131	C8	21P83193A46
C132	B6	21P83193A45
C133	C7	21P83193A47
C134	C7	21P83192A19
C135	D7	21P83192A19
C136	C7	21P83193A46
C138	C2	23P83193A50
C139	D3	21P83192A02
C140	A4	21P83193A45
C141	C3	21P83193A45
C142	D6	21P83192A08
C143	B3	23P83193A51

DIODES

Ref.	Index	Motorola Part No.
CR101	A1	48P83192A52
CR102	A1	48P83192A52
CR103	A2	48P83192A52
CR104	A2	48P83192A52
CR105	B3	48P83193A61
CR106	B4	48P83193A61
CR108	C4	48P83192A54
CR109	C4	48P83192A54
CR110	C5	48P83192A54
CR111	B5	48P83192A54
CR112	B5	48P83192A54
CR113	B3	48P83192A51
CR114	A3	48P83192A51
CR115	A3	48P83192A51
CR116	A3	48P83192A51
CR117	A3	48P83192A09
CR118	A4	48P83192A09
CR119	A8	48P83192A51
CR120	B8	48P83192A51
CR121	C7	48P83192A51
CR122	D7	48P83192A51
CR124	C2	48P83192A51
CR125	C3	48P83192A51
CR127	D2	48P83192A51
CR128	C2	48P83192A51
CR129	D2	48P83192A51

MISCELLANEOUS

B101	A1	24P83192A57
S101	A1	39P83192A58

TRANSISTORS

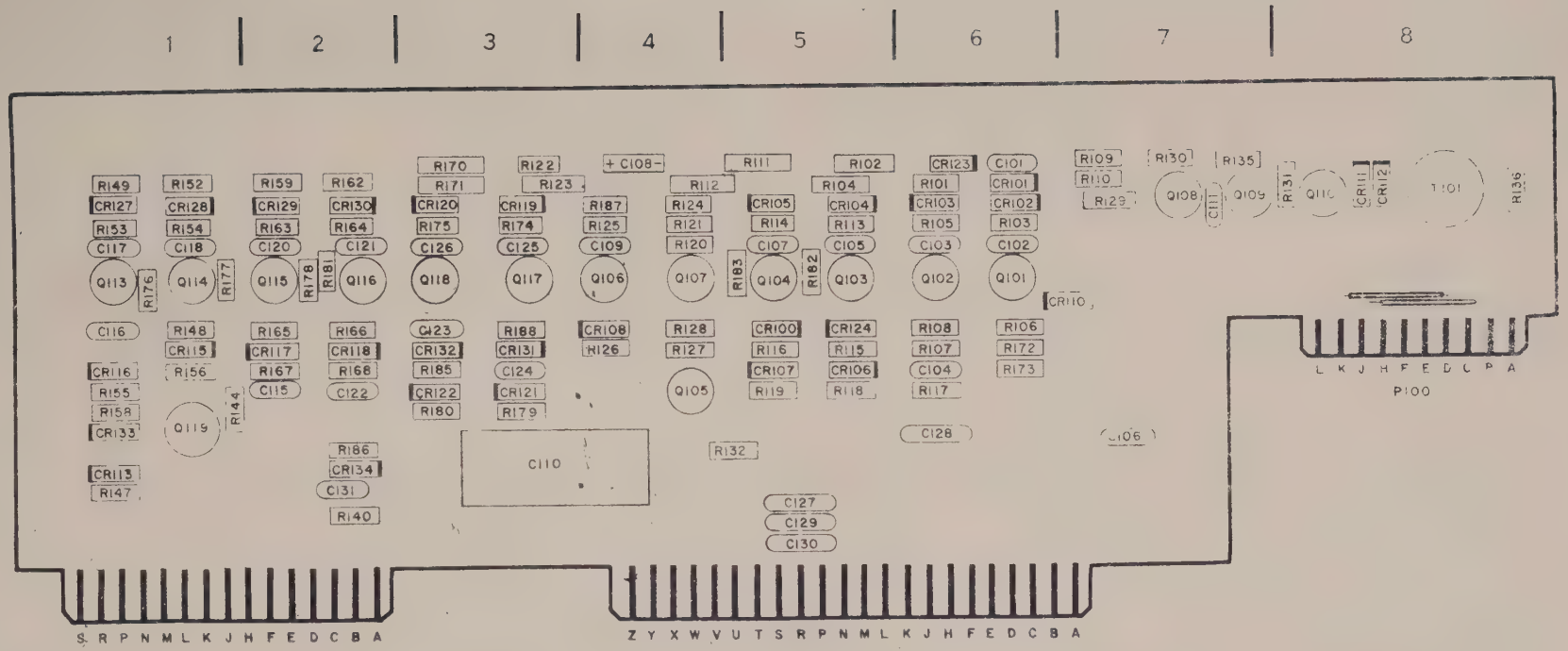
Ref.	Index	Motorola Part No.
Q101	A1	48P83192A47
Q102	B2	48P83192A47
Q103	B2	48P83192A88
Q104	B2	48P83192A47
Q105	A2	48P83192A47
Q106	A2	48P83192A47
Q107	B3	48P83192A47
Q108	B4	48P83192A50
Q109	B3	48P83192A47
Q110	B4	48P83192A50
Q111	C4	48P83192A50
Q112	C4	48P83192A50
Q113	C5	48P83192A50
Q114	B5	48P83192A50
Q115	B4	48P83192A50
Q116	B6	48P83192A50
Q117	B7	48P83192A47
Q118	B7	48P83192A47
Q119	A8	48P83192A47
Q120	B8	48P83192A47
Q121	C8	48P83192A47
Q122	C7	48P83192A47
Q123	D7	48P83192A47
Q124	D8	48P83192A49
Q125	C3	48P83192A64
Q126	C3	48P83193A64
Q127	D3	48P83192A49
Q128	D3	48P83192A49
Q129	D3	48P83192A46
Q130	D2	48P83192A46
Q131	D2	48P83192A46
Q132	C4	48P83192A47

RESISTORS

Ref.	Index	Motorola Part No.
R101	A1	6R6411
R102	A1	6R131289
R103	A1	6R131271
R104	C2	6S125E46
R105	B2	6S124A32
R106	A2	6K129775
R107	B2	6R400153
R108	A2	6S124A12
R109	B	6R129708
R110	B3	6R129708*
R111	B4	6S125A22
R112	C4	6S125A22
R113	B2	6R129709
R114	B2	6K129753
R115	B2	6R129709
R116	A2	6R129779
R117	B2	6R129779
R119	B2	06S10053A44
R120	B6	6R400058
R121	B7	6R129709
R122	B3	6S124A36
R123	C4	6R129709
R124	B3	6R131274
R125	C4	6S124A23
R126	D4	6R129709
R127	C4	6S124A32
R128	C4	6R131274
R129	C5	6S124A23
R130	C5	6R129709
R131	D5	6S124A32
R132	D5	6R131274
R133	C5	6S124A23
R134	C5	6R129709
R135	C5	6S124A32
R136	C5	6R131274
R137	B5	6S124A23
R138	B5	6R129709
R139	B5	6S124A32
R140	B5	6R131274
R141	B4	6S124A23
R142	B4	6S124A32
R143	B4	6R129709
R144	A2	6R400153
R145	A2	18P83193A41
R146	A3	6R400054
R147	A3	6R129667
R148	A3	6R129667
R149	A3	6R129819
R150	B3	6R129982
R151	A6	6S124A32
R152	B6	6R129982
R153	B6	6R129779
R154	B7	6R129805
R155	A7	6R129669
R156	B7	6R129709
R157	B7	6S124A12
R158	A7	6R131525
R159	A9	6S124A32
R160	A8	6S124A42
R161	C8	6R129708
R162	A8	6R129667
R163	C9	6S124A12
R164	D8	6R129708
R165	D8	6R129667
R166	D8	6S124A32
R167	C8	6R129804
R168	C8	6S124A42
R169	C9	6R129667
R170	C8	6R131525
R171	C7	6S124A42
R172	C8	6S124A32
R173	C7	6R129708
R174	C9	6S124A12
R175	C8	6R129667
R176	D8	6R129667
R177	C7	6R129708
R178	C8	6S124A32
R179	D7	6S124A32
R180	D8	6S124A32
R181	D7	6R129667
R182	D8	6R129708
R183	C8	6S124A68
R184	C7	06S10053A74
R185	C8	6R129982
R187	C8	6R129804
R188	C9	6R129667
R189	C9	6R129982
R190	C9	06S10053A78
R191	D9	6R127805
R192	D9	6S124A60
R193	D9	06S10053A55
R194	C9	6S124A58
R195	D9	6R5581
R196	D9	6R2028
R197	D9	6R2028
R198	D9	6R2028
R199	D9	6R555
R200	A1	6S124A54
R201	D9	6R127855
R202	C9	6R127855

Nominal value only

FIGURE 13 – CONTROL CIRCUITS BOARD



Refer to Master Parts Description on page 39.

CAPACITORS

Ref.	Index	Motorola Part No.
C101	A6	21P83192A01
C102	A6	21P83192A02
C103	A6	21P83192A02
C104	B6	21P83192A03
C105	A5	21P83192A04
C106	C7	21P83192A03
C107	A5	21P83192A04
C108	A4	23P83192A05
C109	A4	21K840046
C110	C3	8P83192A06
C111	A7	8P83192A07
C115	B2	21P83192A08
C116	B1	21P83192A02
C117	A1	21P83192A03
C118	A1	21P83192A03
C120	A2	21P83192A03
C121	A2	21P83192A03
C122	B2	21P83192A02
C123	B3	21P83192A02
C124	B3	21P83192A02
C125	A3	21P83192A03
C126	A3	21P93192A03
C127	C5	21P83192A08
C128	C6	21P83192A08
C129	C5	21P83192A08
C130	C5	21P83192A08
C131	C2	21P83192A02

DIODES

Ref.	Index	Motorola Part No.
CR100	B5	48P83192A09
CR101	A6	48P83192A09
CR102	A6	48P83192A09
CR103	A6	48P83192A09
CR104	A5	48P83192A09
CR105	A5	48P83192A09
CR106	B5	48P83192A09
CR107	B5	48P83192A09
CR108	B4	48P83192A10
CR110	B7	48P83192A09
CR111	A8	48P83192A09
CR112	A8	48P83192A09
CR113	C1	28P83192A09
CR115	B1	48P83192A09
CR116	B1	48P83192A09
CR117	B2	48P83192A09
CR118	B2	48P83192A09
CR119	A3	48P83192A09
CR120	A3	48P83192A09
CR121	B3	48P83192A09
CR122	B3	48P83192A09
CR123	A6	48P83192A09
CR124	B5	48P83192A09
CR127	A1	48P83192A09
CR128	A1	48P83192A09
CR129	A2	48P83192A09
CR130	A2	48P83192A09
CR131	B3	48P83192A09
CR132	B3	48P83192A09
CR133	C1	48P83192A09
CR134	C2	48P83192A09

TRANSISTORS

Q101	B6	48P83192A49
Q102	B6	48P83192A49
Q103	B5	48P83192A49
Q104	B5	48P83192A49
Q105	B4	48P83192A42
Q106	B4	48A134525
Q107	B4	48P83192A49
Q108	A7	48A134525
Q109	A7	48P83192A14
Q110	A8	48P83192A15
Q113	B1	48P83192A49
Q114	B1	48P83192A49
Q115	B2	48P83192A49
Q116	B2	48P83192A49
Q117	B3	48P83192A49
Q118	B3	48P83192A49
Q119	C1	48P83192A49

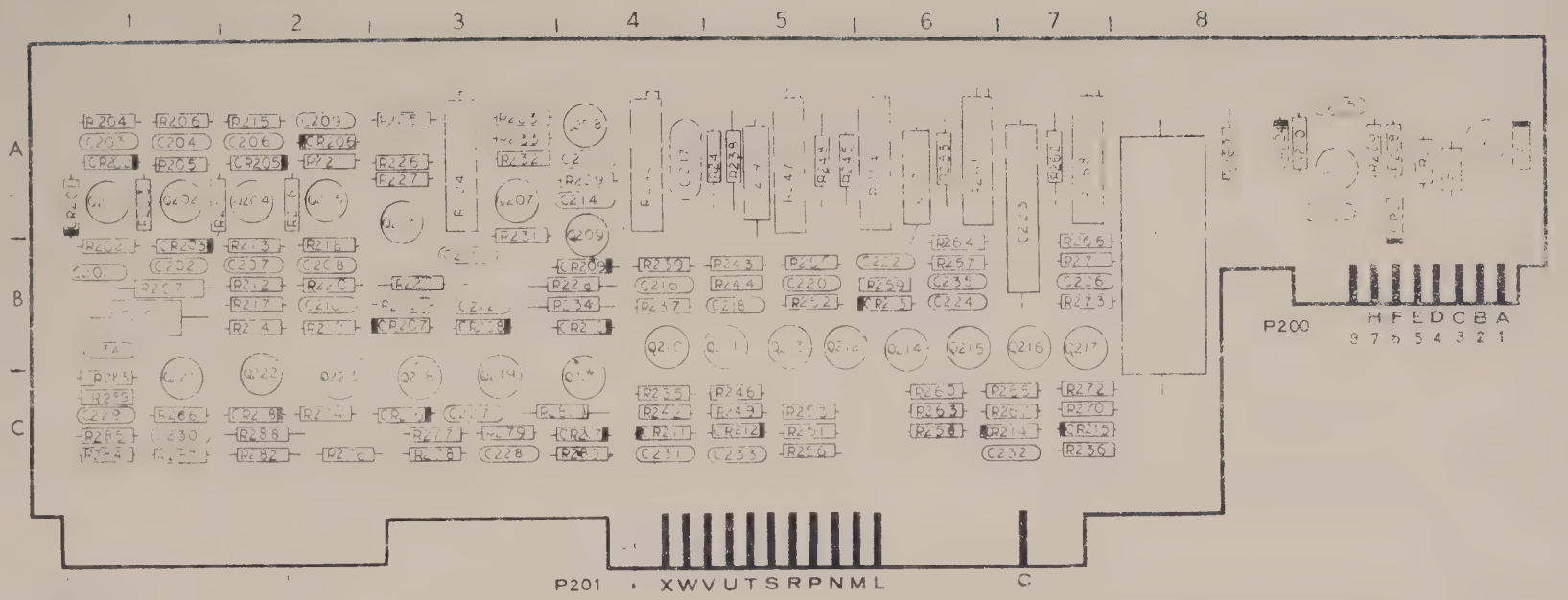
RESISTORS

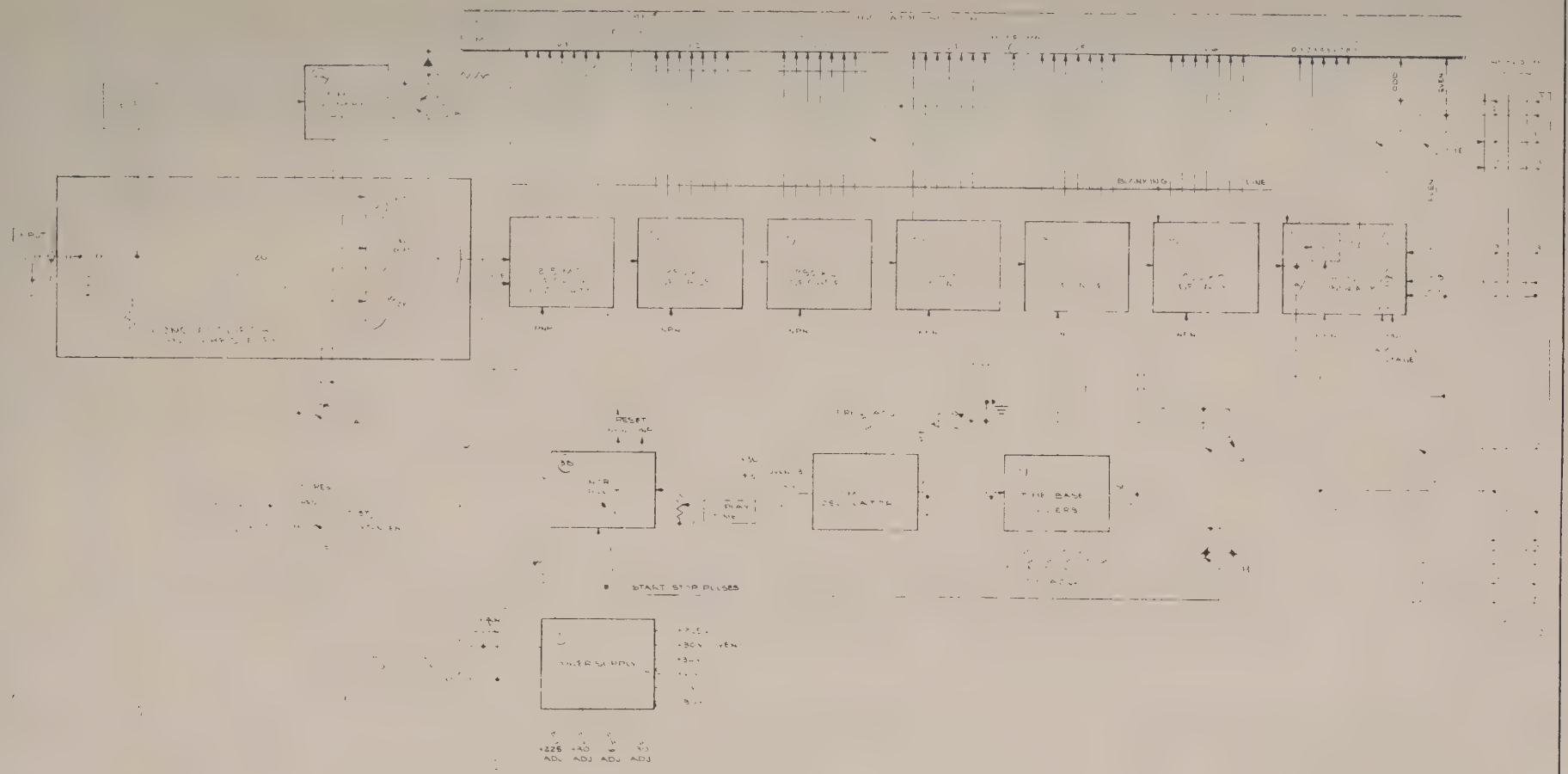
Ref.	Index	Motorola Part No.
R101	A6	6R129981
R102	A5	6R5652
R103	A6	6R129982
R104	A5	6R5652
R105	A6	6R129982
R106	B6	6R129982
R107	B6	6R129886
R108	B6	6R129886
R109	A7	6R129981
R110	A7	6R129981
R111	A8	6R5652
R112	A4	6R5652
R113	A5	6R129982
R114	A5	6R129982
R115	B5	6R129981
R116	B5	6R129981
R117	B6	6R129982
R118	B5	6R129886
R119	B5	6R129886
R120	A4	6K131527
R121	A4	6K131526
R122	A3	6K129526
R123	A3	6R3924
R124	A4	6R124805
R125	A3	6R129982
R126	B3	6R129982
R127	B3	6R129981
R128	B4	6R129886
R129	A7	6R3924
R130	A7	6R129886
R131	A8	6R131527
R132	C5	6K129755
R133	A7	6K131524
R134	A8	6R129668
R140	C2	6K131524
R144	B1	6S124A32
R147	C1	6K129681
R148	B1	6R129886
R149	A1	6R2003
R152	A1	6R2003
R153	A1	6R129982
R154	A1	6R129982
R155	B1	6R129886
R156	B1	6R129836
R158	B1	6R129981
R159	A2	6R2003
R162	A2	6R2003
R163	A2	6R129982
R164	A2	6R129982
R165	B2	6R129982
R166	B2	6R129982
R167	B2	6R129886
R168	B2	6R129886
R170	A3	6R2003
R171	A3	6R2003
R172	B6	6R129709
R173	B6	6R129709
R174	A3	6R129982
R175	A3	6R129982
R176	B1	6R129669
R177	B1	6R129669
R178	B2	6R129805
R179	B3	6R129886
R180	B3	6R129886
R181	B2	6R129805
R182	B5	6R129805
R183	B5	6R129805
R185	B3	6R129981
R186	C2	6R129981
R187	A4	6S124A38
R188	B3	6R129982

MISCELLANEOUS

T101	A8	25P83192A17

FIGURE 14 – TIME BASE DIVIDERS BOARD

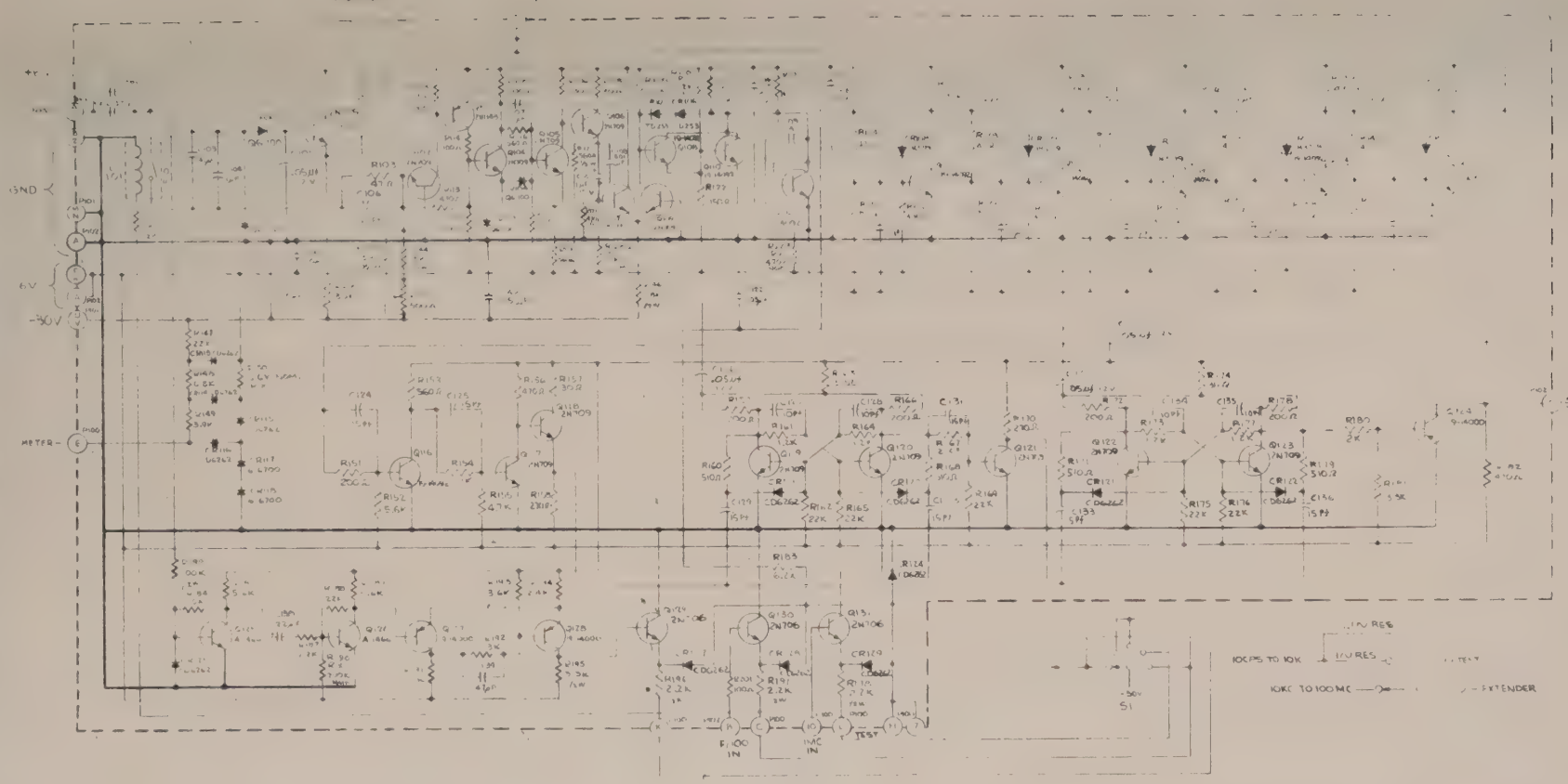




Schematic

BLOCK DIAGRAM

Motorola Dwg. No. 63E-866840



ALL CAPACITORS ±10% 150V MIN
1. ALL RESISTORS ±5% 1/4W
UNLESS OTHERWISE SPECIFIED

Schematic

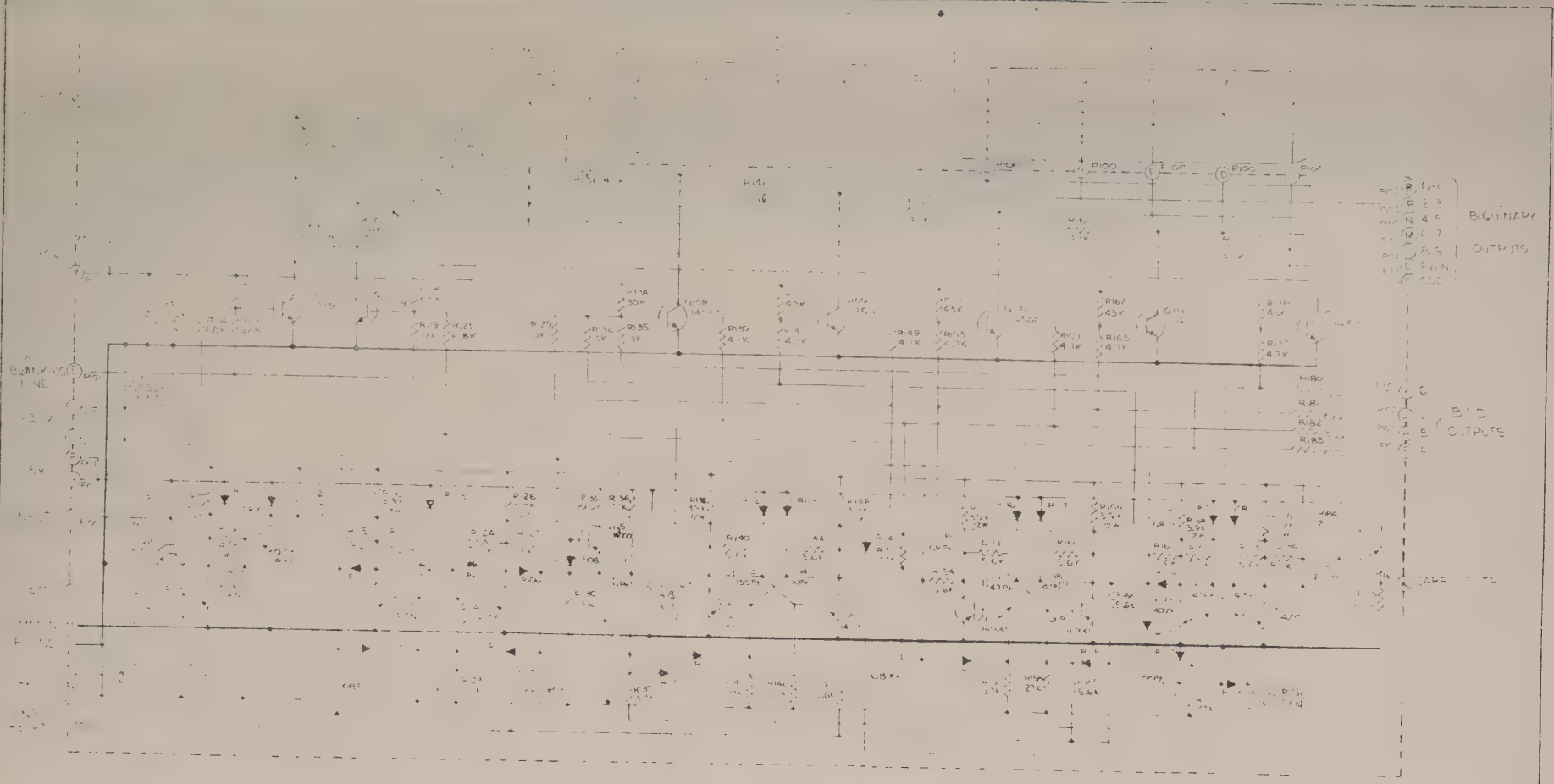
100 MC AMPLIFIER AND PRESCALER

Motorola Dwg. No. 63E-866841

Schematic

CONTROL CIRCUITS

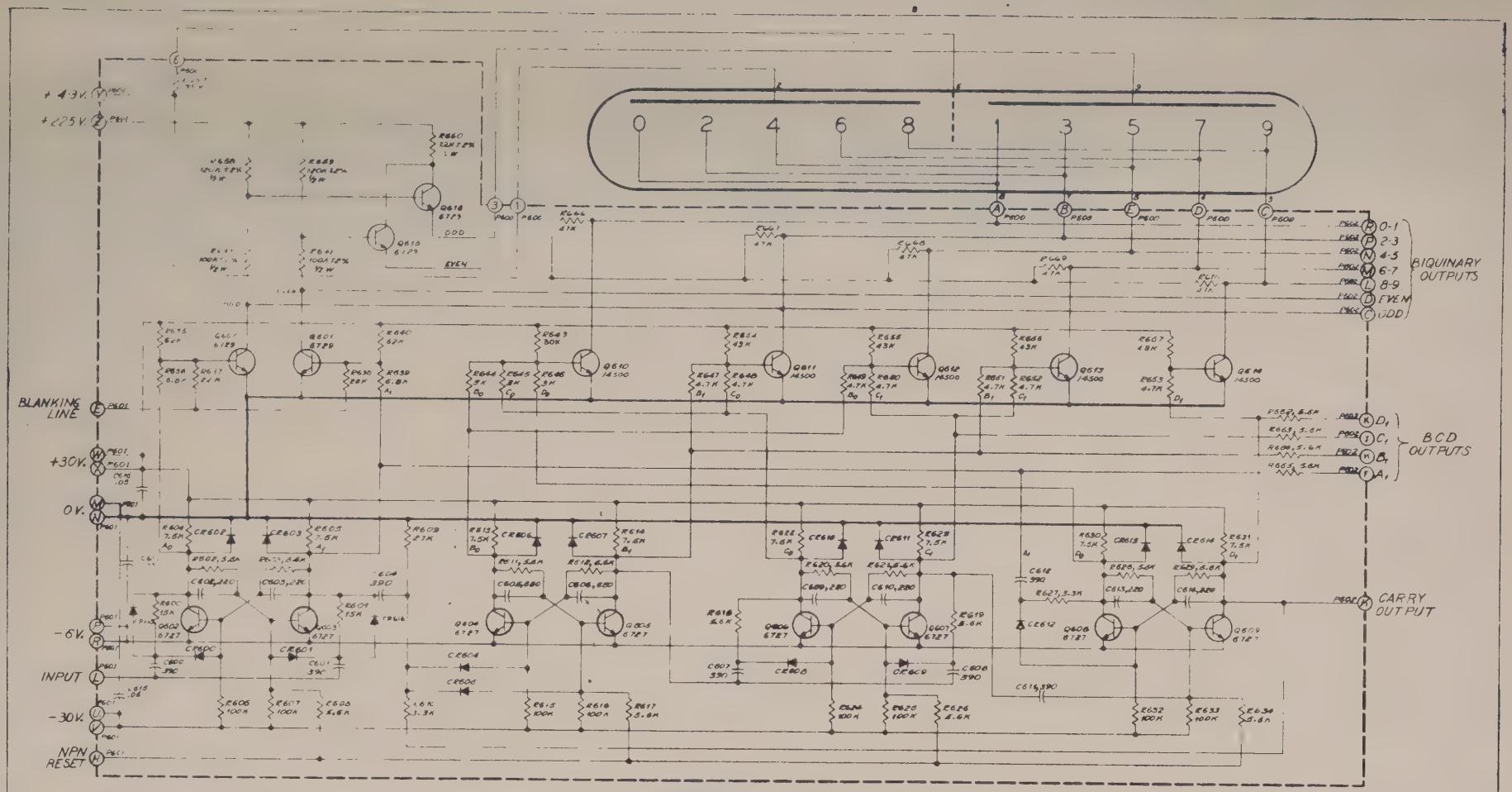
Motorola Dwg. No. 63E-866842



Schematic

2.5 MC DECADE AND GATE

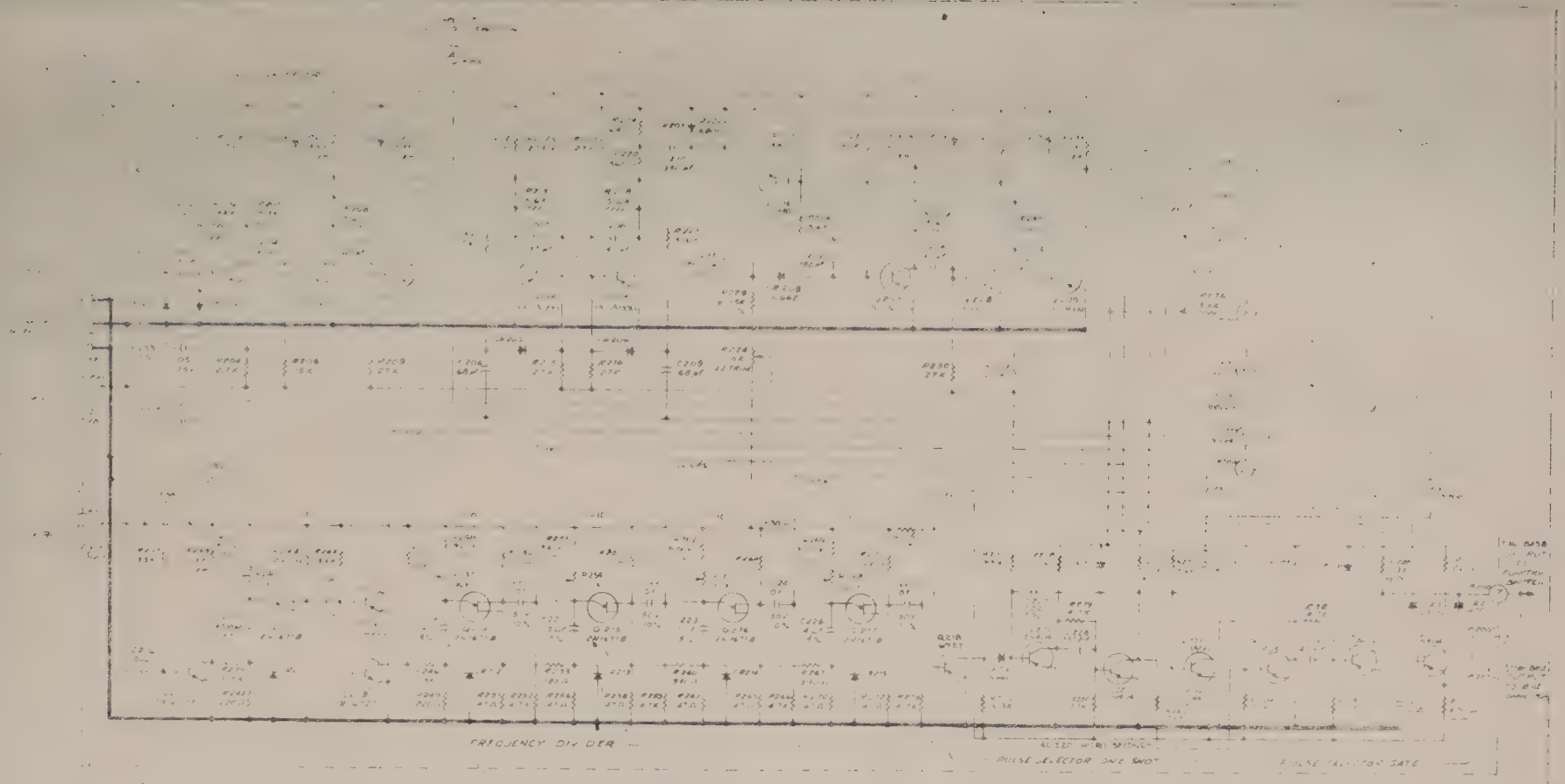
Motorola Dwg. No. 63E-866843



NOTES:
UNLESS OTHERWISE SPECIFIED ON DWG.
1. ALL RESISTORS ±5% 0.25W.
2. ALL CAPACITORS ±10%, 300 V MIN.
3. CAPACITORS VALUED LESS THAN 1.0 TO BE μμfd.
4. CAPACITORS VALUED GREATER THAN 1.0 TO BE μfd.

Schematic
250KC DECADE
Motorola Dwg. No. 63E-866844

D

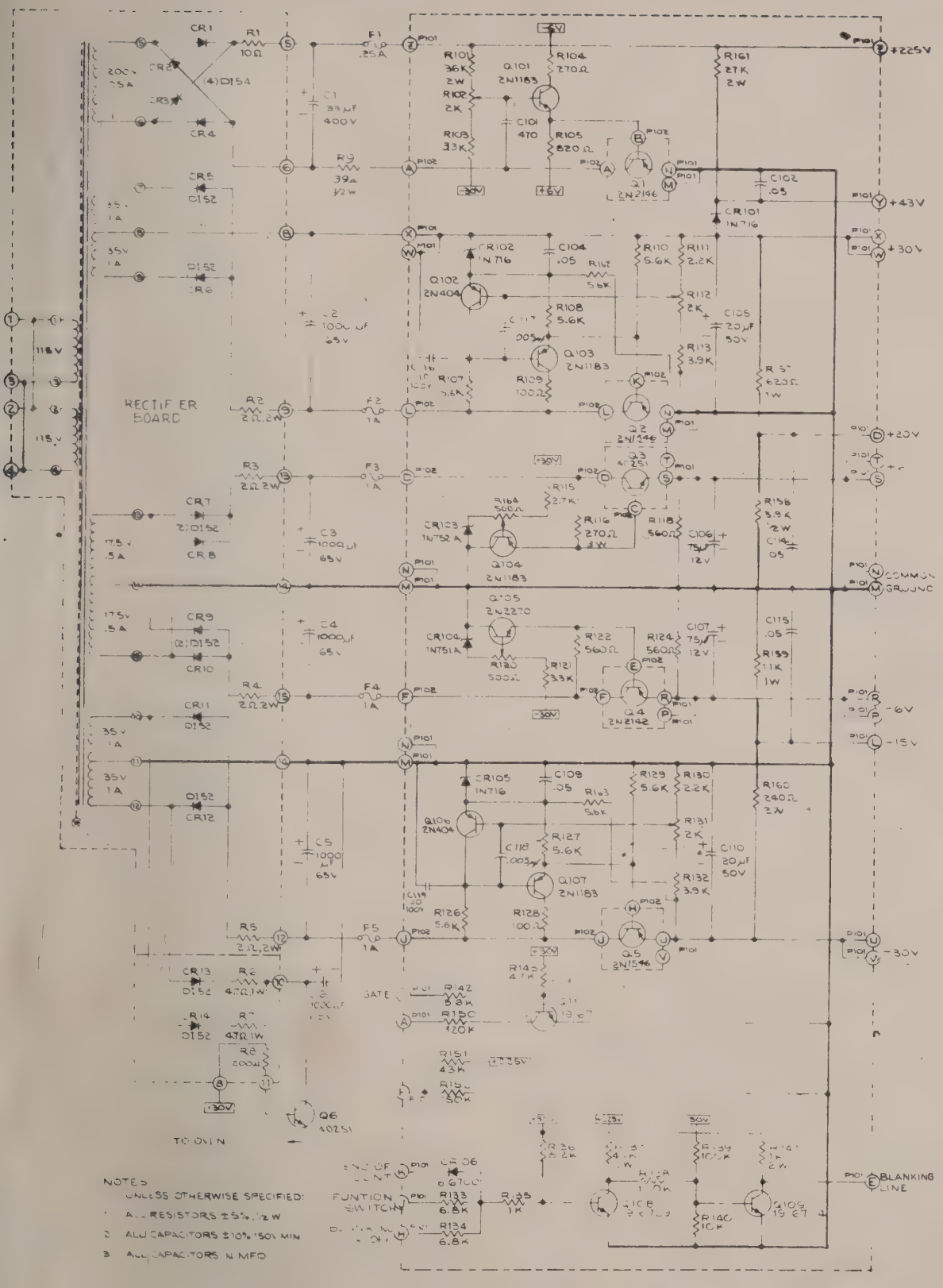


NOTES:

Schematic

TIME BASE

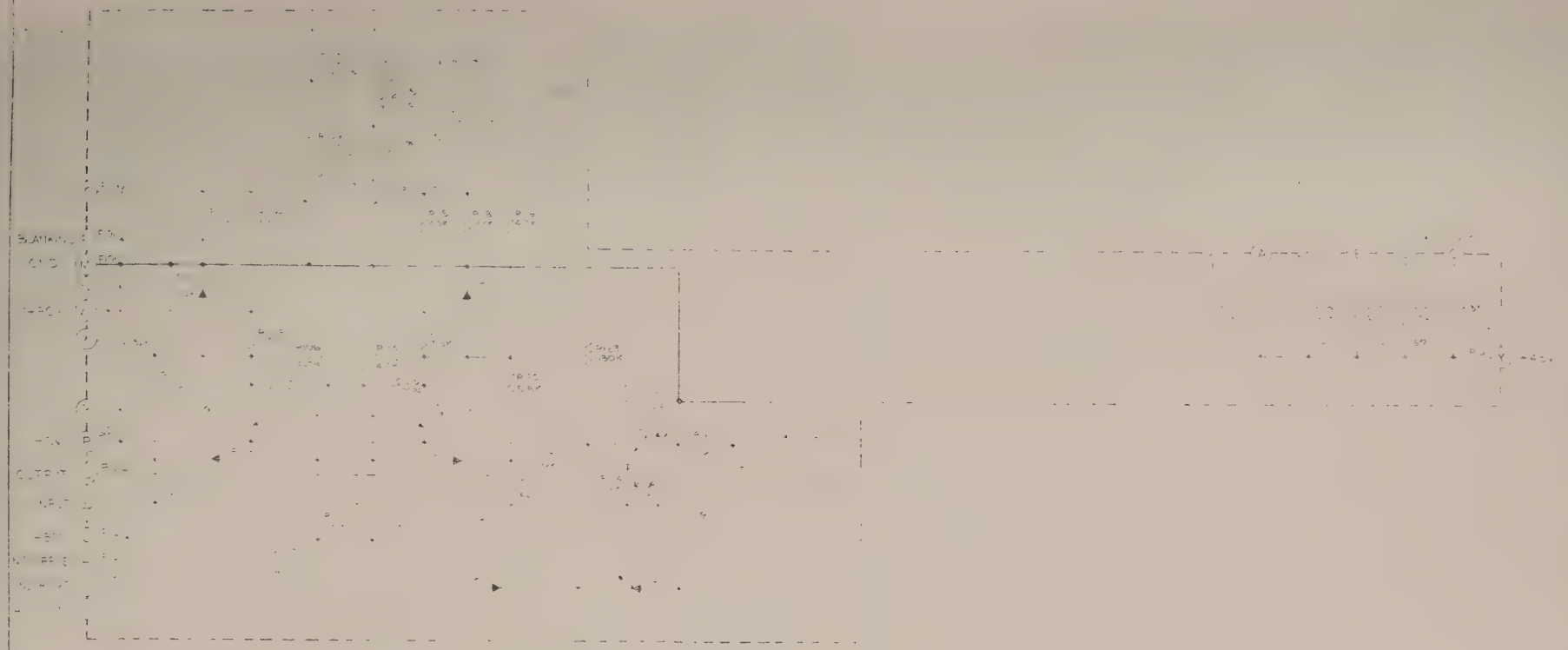
Motorola Dwg. No. 63E-866845



Schematic

POWER SUPPLY

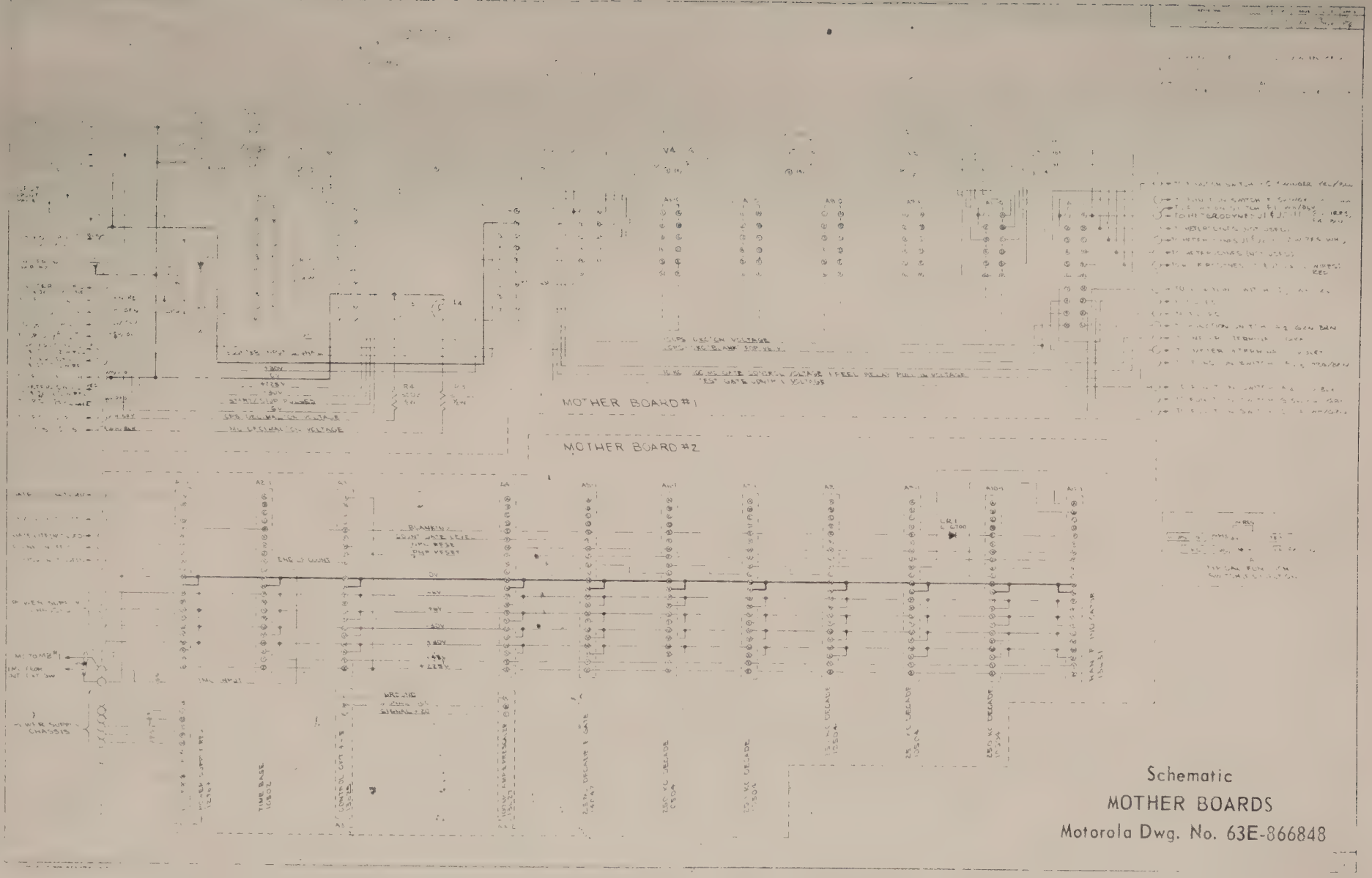
Motorola Dwg. No. 63E-866846 F



Schematic

RANGE INDICATOR

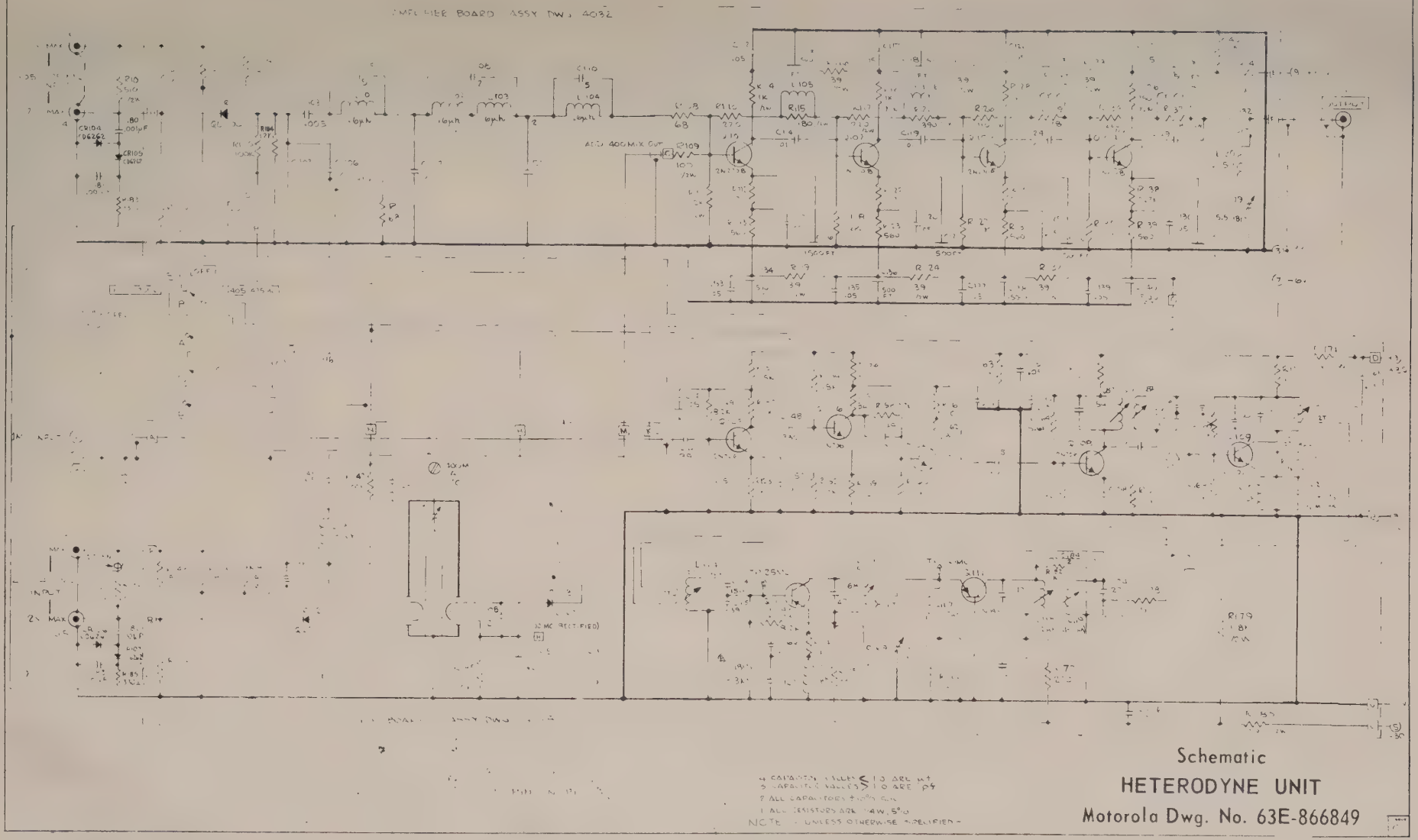
Motorola Dwg. No. 63E-866847



Schematic

MOTHER BOARDS

Motorola Dwg. No. 63E-866848



Schematic

HETERODYNE UNIT

Motorola Dwg. No. 63E-866849

METER CIRCUIT CHANGES

The meter circuit in the Model S1075A has been completely revised. The revisions provide much improved meter performance. Schematic diagrams illustrating the changes and additions are included on a separate sheet and should be kept with the Instruction Manual.

The Meter adjustment procedure given in paragraph 5.8.5.6 of the Instruction Manual should be disregarded and the following procedure followed.

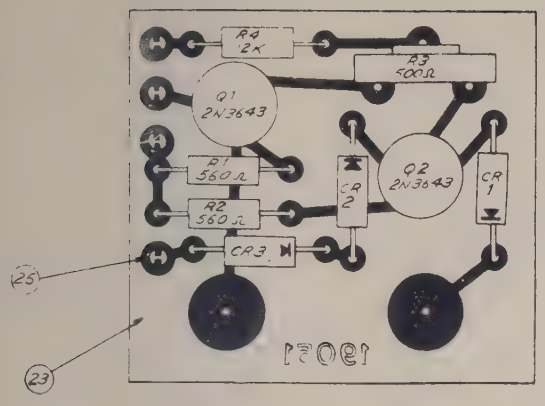
Meter Adjustment:

1) With S1075A Power OFF adjust the mechanical zero of the meter. This adjustment is located on the meter panel just below the face of the meter.

2) With the plug-in removed, turn the S1075A power ON and apply a 100MC signal with a precise 100mv rms amplitude.

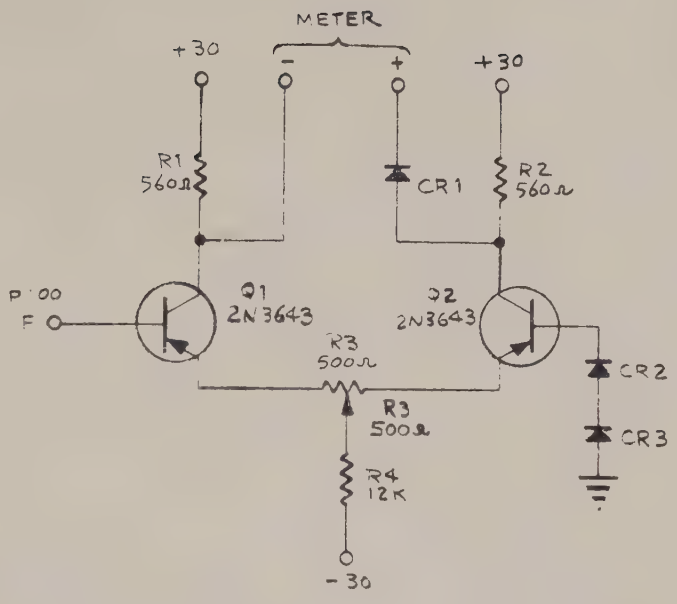
3) Adjust R3 until the meter indication is just at the left edge of the green area. R3 is located at the bottom of the meter board which is installed immediately behind the meter.

This procedure calibrates the meter for all of the positions in which the meter is connected. All signals to be measured must be within the green area of the meter. It is particularly important to observe the upper limit of the green area of the meter. Signals which cause the meter to read in the upper or right red area MAY CAUSE DAMAGE TO THE INSTRUMENT.



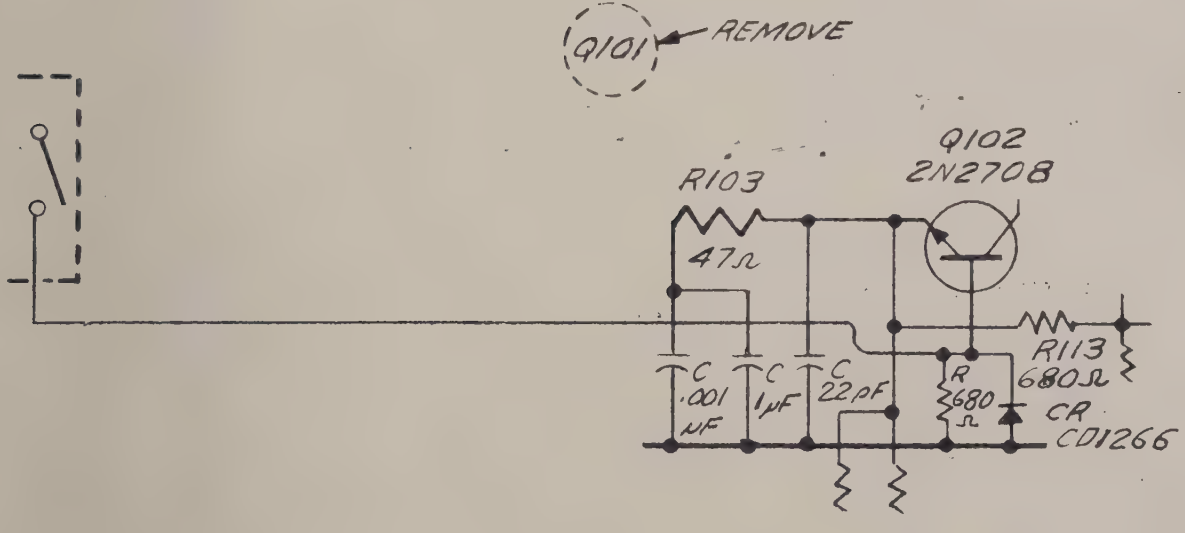
TITLE:
METER CIRCUIT
PC BOARD-
ASSEMBLY

NOTE:
1) RESISTORS ¼W 5%.
2) DIODES CD6262.
3) SCHEMATIC - 19052.
& 19060.



NOTE:
1) RESISTORS --- ¼W 5%.
2) DIODES ARE CD6262.

DWG NO.
19052



REVISED SECTION OF
SCHEMATIC 14187

MOTOROLA

INSTRUCTION MANUAL REVISION MR-2564

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL(S) AFFECTED:

Deviation Monitor, Frequency Synthesizer

REVISION DETAILS

With this change the following becomes effective:

Instruction Manual No.	Schematic Diagram	New Issue	Sampler Board	Suffix	Ckt. Bd. Detail
68P81057A35-A	63E81046A18	B2	SLN6215A	None	PEPD-16470-E

(1) Component Changes

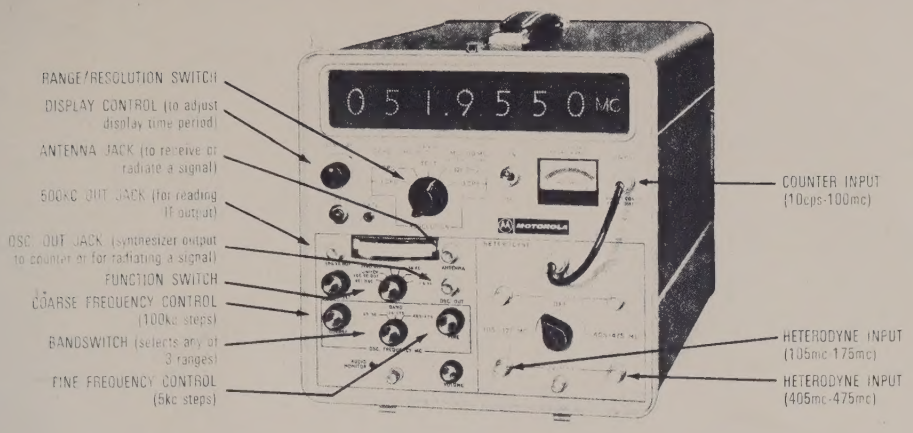
Ref. Sym.	Action	Part Number	Description
Q2, 10	Changed to	48R869454	TRANSISTOR, N-Channel insulated silicon effect; type M9454 gate
R56	Added		VALUE selected at factory, SEE WIRING CHANGE

(2) Wiring Change

R56 is connected between CR3, CR4 anodes and CR5, CR6 cathodes.

MR-2564
10/31/69

MOTOROLA S 1079A DEVIATION MONITOR / SYNTHESIZER


RANGE/RESOLUTION SWITCH
DISPLAY CONTROL (to adjust display time period)
ANTENNA JACK (to receive or radiate a signal)
500KC OUT JACK (for reading IF output)
OSC. OUT JACK (synthesizer output to counter or for radiating a signal)
FUNCTION SWITCH
COARSE FREQUENCY CONTROL (100kc steps)
BANDSWITCH (selects any of 3 ranges)
FINE FREQUENCY CONTROL (5kc steps)
051.9550 MC
COUNTER INPUT (10cps-100mc)
HETERODYNE INPUT (105mc-175mc)
HETERODYNE INPUT (405mc-475mc)

SETTING A FREQUENCY

A. Set function switch to SET OSC. position.

B. Set bandswitch to desired frequency range.

C. Connect OSC. OUT jack to either counter or heterodyne input (i.e. 10 cps-100mc, 105 mc-175mc, 405-475mc).

D. Set RANGE/RESOLUTION knob on counter for 100 cps resolution and display control for short display (counterclockwise).

E. Adjust the Fine Frequency Control (5Kc steps) to obtain the desired 10Kc and Kc digits.

F. Adjust the Coarse Frequency Control (100 Kc steps) to obtain the desired 10Mc, 1Mc, and 100 Kc digits.

SIGNAL RADIATION FOR RECEIVER FREQUENCY ADJUSTMENTS

A. Set up the desired frequency as above.

B. Connect the antenna to the OSC. OUT jack for maximum output or to the ANTENNA jack if less signal output is desired.

MEASURING TRANSMITTER DEVIATION

A. Connect antenna to ANTENNA jack.

NOTE: In the presence of a strong signal, remove the antenna to avoid overloading.

B. Set frequency as described in A thru E except set frequency ± 500KC of transmitter operating frequency to provide proper heterodyne frequency for deviation monitor (I.F. frequency of deviation monitor is 500KC).

C. Set function switch to LIMITER/500KC OUT. Key transmitter and observe that limiter reading is past indicator line and that monitored audio is "quieted".

D. Move function switch to next position, ZERO SET, and observe if meter is zero; if not adjust with ZERO SET knob.

E. Move function switch to next position (s) selecting desired deviation range, 16KC, 8KC, or 1.6KC.

F. Key transmitter modulated with a 1000 CPS audio tone and read deviation on meter.

MEASURING TRANSMITTER FREQUENCY WITH HIGH ACCURACY/ RESOLUTION

With the oscillator set up as in step A and B for deviation, it is possible to read the transmitter frequency error to resolutions better than 10cps by monitoring the 500KC IF output on the digital read-out as follows:

A. Move function switch setting to LIMITER/ 500KC OUT.

B. Connect interconnect cable from 500KC OUT jack to counter INPUT.

C. Key transmitter and observe digital read-out. If transmitter is "on frequency", read-out will be 500KC. Any error in transmitter frequency will be added to or subtracted from 500KC.

NOTE: See Instruction Manual for detailed instructions.

MOTOROLA Communications and Electronics Inc.
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TECHNICAL INFORMATION CENTER

Part No. 54C82256B48 TIC-3177

MP MASTER
MA36329